DRAFT ENVIRONMENTAL IMPACT STATEMENT

IMPROVEMENT DREDGING

FALL RIVER HARBOR

MASSACHUSETTS AND RHODE ISLAND

JULY 1982

US Army Corps of Engineers
New England Division

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SUMMARY

This environmental impact statement is prepared for a proposed Federal action which would result in deepening of channels into Mount Hope Bay, located in Rhode Island and Massachusetts.

The project described is a portion of that authorized by Congress in 1968, and encompasses the deepening of navigation channels to a usable depth of 40 feet at mean low water. This will require excavation and disposal of approximately 4.0 million cubic yards. The dredged material would be placed in barges and towed to the Brenton Reef Disposal Site where the spoil would be dumped within a discrete area at a taut wire buoy. Construction costs total about $23 million or $1,027,000 on an annual basis. Benefits which derive from economies of scale and reductions in delay to channel users are computed at $4.6 million, which when compared with the estimated cost of work gives a favorable relation of benefits to cost on an annual basis.

In addition to the above proposed Federal action, five companies located along the Fall River Harbor have expressed interest for Corps permits to dredge their entrance channels and berthing areas. These called for areas to be dredged to 40 feet below mean low water to allow the companies to make use of the proposed 40-foot Federal channel. The total volume of sediments to be removed and deposited at the Brenton Reef site by the applicants would be about 850,000 cubic yards. Both the Corps' and the applicants' dredging and disposal operations would be coordinated to reduce environmental impacts in the bay or at the disposal grounds. The disposal site would be managed to minimize impacts on fisheries.

The project to deepen the Fall River Harbor to 40 feet was authorized by Congress in 1968. In October 1971, the Corps of Engineers issued the first Draft EIS on deepening the Federal Channel with disposal at Brenton Reef Disposal site. The U.S. Environmental Protection Agency (EPA) stated that disposal at Brenton Reef would violate the Environmental Protection Agency and Rhode Island's water quality standards. Subsequently the Federal Water Pollution Control Act (FWPCA) and the Marine Protection, Research and Sanctuaries Act (Ocean Dumping Act) were enacted. In response to a renewed interest in the project a second Draft EIS was issued in February 1976 with a new disposal site, suggested by agencies of Massachusetts and Rhode Island, located a few miles southeast of Browns Ledge. The new site was opposed by Congressional interests, Federal and other State agencies, cities and towns, and the general public and work ceased on the project. The project became active again in 1980 when the Corps was requested to reaffirm the project's viability.

Three alternatives to the authorized project were evaluated. These were an off-loading facility at Mount Hope Bay entrance with pipelines to users; deepen the existing channel into Tiverton, Rhode Island with transfer by rail or pipeline to Fall River; and No Action (no improvement beyond the 35 foot depth).

The three optional methods to achieve the needs, that is, the economical movement of commodities to the Fall River area did not survive scrutiny as being either more economical to construct or as presenting opportunities for more environmentally acceptable methods of accomplishment. Thus there are no significant gains in choosing an approach that may in fact involve greater risk.

Evaluation of optional methods of disposal focuses on the key issue which has attended this project over the years. Among the options initially considered, the following were chosen for evaluation as being reasonable or practicable:

- upland disposal
- shallow water containment
- aquatic disposal

Upland disposal would require almost 450 acres, and the urbanized nature of Fall River made this alternative unsuitable due to lack of available sites. Shallow water containment sites were also reviewed and a preliminary design developed for a facility at Spar Island. Disposal at this location is unfavorable since costs would be excessive due to difficulty in constructing and filling the container. In addition, the construction cost for this facility would either have to be borne by non-Federal interests or additional Congressional authorization be given to include the container as a Federal expense. In the period 1971 to date neither of these options has been pursued by either non-Federal or Congressional interests.

With the entire ocean available for consideration, the infinite number of sites was narrowed down to those on which sufficient information was available to make reasonable judgments in light of site selection criteria. Of the two sites which are within reasonable distance and on which information is available, Brenton Reef and Brown's Ledge, Brenton Reef was selected as being the most economical and least disruptive to the existing users of the ocean bottom.

Throughout the study, close coordination was maintained between the Corps and concerned Federal and State agencies. Massachusetts and Rhode Island agencies were very active in developing the sampling and testing program used to determine the quality of the Fall River channel sediments. State and Federal agencies also participated as panelists in three public workshops held in July 1981.

The major conclusions gained from the workshops were that the sediments should create no unacceptable impacts outside of the disposal site. There was general but not universal agreement at the workshops that upland disposal was not a realistic option. One session of the workshops was held for the local fishing community; those attending were adamantly opposed to any open water disposal.

The major impacts that would occur from this proposal would be the burial of shellfish and lobsters at the disposal site. This impact would be unavoidable under preferred proposal.

I. PURPOSE AND NEED

The purpose of the Fall River Harbor Improvement Dredging Project is to modify the existing project to meet the deep draft navigation needs expressed by the public in that region.

The improvement project was authorized by the River and Harbor Act of 13 August 1968 (PL 90-483).

The needs addressed by this project are those concerned with providing safe navigation within the port area for both existing and future vessel traffic, and for improving the cost effectiveness of present and future waterborne commerce activity within the port.

Local interests in Rhode Island and Massachusetts have demonstrated the need for removal of obstructions and increasing channel depths in order to reduce accidents and transportation costs of vital waterborne commodities such as petroleum products and coal, with savings to the public at large in both states.

The project was formulated to provide the most effective way of meeting the needs of the general public.

II. AFFECTED ENVIRONMENT

Introduction

Fall River harbor is situated at the head of Mount Hope Bay, a northeasterly arm of Narragansett Bay, in the states of Massachusetts and Rhode Island. The bay is separated from Narragansett Bay to the south and west by a peninsula (Bristol, RI) and Aquidneck Island. To the south is the Sakonnet River, which is a tidal strait running north-south that connects Mount Hope Bay to Rhode Island Sound. The main sources of fresh water into the bay are the Taunton, Lee, Cole and Quequechan Rivers in Massachusetts and the Kickamuit River in Rhode Island. (See Figure 1.) The harbor itself is located approximately 50 miles southwest of Boston, Massachusetts; 20 miles south of Providence, Rhode Island; and 22 miles north of the entrance to Narragansett Bay. The width of the harbor varies from 2.5 miles at the lower extremity to about 1,000 feet at its upper end. Its length is about 7 miles. The mean tidal range is 4.4 feet. Vessel traffic moves from Rhode Island Sound up into the well sheltered and relatively deep waters of Narragansett Bay. After about 4 miles of steaming, the vessels either continue up the bay to the Providence River in Providence, Rhode Island, or they move into Mount Hope Bay and up to the port facilities at Fall River. Providence and Fall River are the two major ports for this area.

The city of Fall River is highly industrialized, and has a highly concentrated downtown area. Along the bay and up the Taunton River is a small band of fairly level land where many of the area's industries have settled. Behind this flat area, the land rises sharply: over 200 feet in elevation within a 3,000 foot distance. The area surrounding the city is primarily residential. This is also the case on the southern side of the bay; however there are some working farms present in the Bristol Neck. Some fairly large stands of eastern hardwoods are found throughout the bay uplands.

Socioeconomic Setting

Fall River Harbor principally serves the communities within the Fall River Standard Metropolitan Statistical Area (SMSA). The Fall River SMSA includes Fall River and the towns of Somerset, Swansea, and Westport in Massachusetts, and the town of Tiverton in Rhode Island.

Although population in the SMSA has shown growth for each decade since 1950, population in the city of Fall River has continued to decline as shown in Table 1. The 1980 population of 92,574 is a 4.5 percent decrease from the 1970 population. The Fall River population makes up 60 percent of the SMSA's population with a population density of 2,815 persons per square mile.

Table 1

Population
Fall River and the SMSA

Year	Fall River		Fall River SMSA	
	Number	Percent Change from Previous Decade	Number	Percent Change from Previous Decade
1950	111,963		134,589	
1960	99,942	-10.7	138,156	2.7
1970	96,898	- 3.0	149,976	8.6
1980	92,574	- 4.5	154,137	2.8

Thirty-year projections of population for Fall River and the Fall River SMSA are suggested in Figure 2. The upper limit of growth for the SMSA is obtained by using the rate of increase from 1950 to 1980 while the lower limit reflects the 1970 to 1980 rate of increase. The upper limit for Fall River assumes a reduced decline in population followed by slight growth while the lower limit continues the average rate of decrease from 1960 to 1980.

Economy and Employment

Early industries included whaling and fishing, shipbuilding, the making of pottery, bleacheries and dye works. These industries were soon superseded by the textile industry, which not only dominated the SMSA's economy but also the State's during the early 1900's.

Fall River provided the necessary setting for the development of the textile industry, excellent water power, a mild and moist climate, and harbor facilities adequate for trade shipments. When the textile industry began its decline in the 1920's many of the large firms in Fall River closed down and moved south.

The arrival of the apparel industry into Fall River partially offset the loss of jobs and payrolls resulting from the textiles decline. However, the apparel industry relies on a large percentage of female labor, so many skilled male laborers remained out of work. Unemployment was reduced with the appearance of other industries such as rubber, plastics, printing and electrical equipment in the area.

The Massachusetts Division of Employment Security reported that in 1980, Fall River had 1,761 firms with an annual payroll of $435,555,700 and an average employment figure of 40,861.

Although employment in manufacturing decreased by almost 10 percent between 1970 and 1980, the manufacturing sector remained the predominant employer, employing close to 45 percent of the workforce. The services sector showed the biggest growth in employment between 1970 and 1980, increasing close to 200 percent. This sector, therefore, showed the most sizable increase in the proportion of the total work force employed, from 7.5 percent in 1970 to 18.7 percent in 1980. Table 2 provides a breakdown of employment by industry for 1970 and 1980.

Table 2

Employment by Industry
1970-1980
Fall River, MA

	1970		1980		
	Number Emp.	% of Total	Number Emp.	% of Total	Percent Change From 1970-1980
Agriculture, Forestry, Fisheries	33	0.1	61	0.2	84.
Construction	1,103	3.1	831	2.0	-24.
Manufacturing	20,184	56.8	18,179	44.5	-9.9
Trans., Comm., & Util.	2,210	6.2	1,292	3.2	-41.5
Wholesale/Retail Trade	7,509	21.1	6,826	16.7	- 9.1
Fin., Ins., & Real Estate	1,837	5.2	2,367	5.8	28.9
Services	2,647	7.5	7,644	18.7	188.8
Govt.	-		3,661	8.9	
Total	35,525	100.0	40,861	100.0	18.0

Within the Fall River Labor Market Area* (LMA), the manufacturing sector employed approximately 35 percent of the work force, a smaller proportion than that in Fall River itself. Employment in the wholesale and retail trade sector ranked second to manufacturing, accounting for close to 20 percent of the employed, followed by the services sector.

*The Fall River Labor Market Area consists of Fall River, Dighton, Somerset, Swansea, and Westport in Massachusetts and Little Compton and Tiverton in Rhode Island.

Average annual employment in Fall River in 1981 was 42,103. The number unemployed was 4,289, yielding an unemployment rate of 9.2 percent. The rate of unemployment for the SMSA was slightly improved at 8.4 percent, but still fell short of the 6.4 percent rate experienced by the state. This data is presented below in Table 3.

Table 3

Average Annual Employment 1981
Fall River, Fall River SMSA, and Massachusetts

	Fall River	SMSA	Massachusetts
Labor Force	46,392	14,270	2,961,000
Employed	42,103	68,018	2,773,000
Unemployed	4,289	6,252	188,000
Employment Rate	9.2	8.4	6.4

There have been several recent significant shifts in the industrial section which relate directly to the continued viability of Fall River Harbor. One has been the construction of a large petrochemical facility which manufactures synthetic natural gas using naptha as a feedstock. The plant is located immediately north of Fall River. It employs 103 people on a year-round basis and relies heavily on the harbor for importing its feedstock.

A second shift occurred when Firestone completely closed down its Fall River operation on the harbor just south of the state pier. Tillotson Industries, a collection of relatively small manufacturing activities, has taken over the Firestone facilities and employs about 200 in latex and other chemical products manufacturing.

A third major economic change in the Fall River area would occur if the EG&G energy park, now undergoing a full feasibility study, is constructed. That operation is projected to be in operation in 1988-89. The Chamber of Commerce estimates that the EG&G operation would generate eight to ten additional industrial plants utilizing their by-products and energy. It is expected that the EG&G facility will employ about 5000 people during construction and 1000 people on a permanent basis. No estimates have been made of the "spinoff" effects of other industries on area employment.

A 500-acre Industrial Park in the northeast section of Fall River presents additional opportunities for industrial expansion.

Fall River Harbor Commercial Background

Latest data available indicate that the 1979 level of waterborne commerce received at Fall River Harbor was 4,798,674 short tons. This is a 13 percent increase over the past 10 years and a 120-percent increase over the past 20 years. Table 4 displays waterborne commerce flows 1955-1979.

Table 4

Historical Waterborne Commerce

Year	Short Tons	Year	Short Tons
1955	2,013,131	1968	3,541,631
1956	2,201,889	1969	4,261,327
1957	2,101,120	1970	4,333,530
1958	2,101,916	1971	3,970,302
1959	2,174,230	1972	4,300,619
1960*	2,942,012	1973	4,625,362
1961	2,179,633	1974	5,122,188
1962	2,599,329	1975	4,834,393
1963	2,737,650	1976	4,739,073
1964	3,161,590	1977	5,285,473
1965	3,661,963	1978	4,820,427
1966	4,040,441	1979	4,798,674
1967	3,850,063		

*1960 tonnage shows an abnormal increase over the previous year due to 770,000 tons of granite designated for breakwater construction at Newport, Rhode Island.

Table 5

Fall River Harbor
Freight Traffic, 1979
(Short Tons)

	Commodity	Total	FOREIGN Imports	FOREIGN Exports	DOMESTIC Coastwise Receipts	DOMESTIC Coastwise Shipments	DOMESTIC Internal Receipts	DOMESTIC Internal Shipments	Local
	Total	4,798,674	1,459,213	20	3,014,257	110,912	152,591	53,984	7,697
0841	Crude Rubber and Gums	12,134	12,134	20	-	-	-	-	-
0912	Shellfish, exc. Prepared	739	-	-	-	-	739	-	-
2631	Paper and Paperboard	20	-	-	-	-	-	-	-
2810	Sodium Hydroxide	4,851	-	20	4,851	-	-	-	-
2817	Benzene and Toluene	896	-	-	896	-	-	-	-
2818	Sulphuric Acid	19,100	-	-	19,100	-	-	-	-
2819	Basic Chemicals, NEC	7,234	7,234	-	-	-	-	-	-
2911	Gasoline	913,911	199,210	-	707,016	6,790	-	975	-
2912	Jet Fuel	64,832	-	-	63,177	-	1,655	-	-
2913	Kerosene	49,682	-	-	33,118	6,058	-	10,506	-
2914	Distillate Fuel Oil	762,631	30,483	-	561,181	81,915	38,852	42,503	-
2915	Residual Fuel Oil	2,326,228	1,147,435	-	1,067,448	-	111,345	-	-
2916	Lube Oils and Greases	17,872	-	-	17,872	-	-	-	-
2917	Naptha, Pet. Solvents	547,308	-	-	539,420	7,888	-	-	-
2918	Asphalt, Tar, etc.	62,717	62,717	-	-	-	-	-	-
2991	Pet. & Coal Prod. NEC	178	-	-	178	-	-	-	-
3312	Slag	8,261	-	-	-	8,261	-	-	-

Fall River is primarily a receiving port as shown in Table 5. Of the 4,798,674 short tons received in 1979, 96 percent was receipts. The breakdown by source is imports (31.5%), coastwise (65.2%) and internal (3.3%).

A a receiving port, the major commodities received are petroleum products. In 1979, petroleum accounted for 98.9 percent of total commerce received. Over the past 10 years this group of products has grown from 76.4 percent to 98.9 percent of receipts. A breakdown of the types of petroleum products is found in Table 6.

Table 6

Petroleum Products Received in 1979

1979:

SIC Group 29	Product	Short Tons	Percentage
2911	Gasoline	913,991	19.3%
2912	Jet Fuel	64,832	1.4%
2913	Kerosene	49,682	1.0%
2914	Distillate	762,631	16.1%
2915	Residual	2,327,228	49.0%
2916	Lube Oils & Gr.	17,872	0.4%
2917	Naptha, Pet. Solv.	547,308	11.5%
2918	Asphalt, Ter. Pitch.	62,717	1.3%
2991	Pet., Coal Prod. NEC	178	0.004%
	TOTAL	4,745,439	

Of all New England ports which have deep draft channels, Fall River Harbor ranks seventh in terms of total tonnage of waterborne commerce. While the ten largest ports all have very large shares of petroleum tonnage, Fall River has the largest share with 98.9 percent. Table 7 displays the ten largest New England ports ranked in terms of total waterborne commerce tonnage and petroleum tonnage as of 1979.

Table 7

Total Waterborne Commerce and Petroleum
Commerce in the Ten Largest New England Ports
(in short tons)
1979

Port	Total Tonnage	Petroleum Tonnage*	Percent Petroleum
Boston, MA	26,342,672	24,005,999	91.1%
Portland, ME	13,262,431	11,719,626	88.4%
New Haven, CT	10,622,395	9,592,420	90.3%
Providence, RI	8,579,917	7,437,578	86.7%
Chelsea River, MA (incl in Boston)	7,895,531	7,699,323	97.5%
Mystic River, MA (incl in Boston)	7,478,569	6,531,867	87.3%
Fall River, MA	4,798,674	4,745,439	98.9%
Portsmouth, NH	3,519,926	3,007,449	85.4%
Bridgeport, CT	3,243,301	2,636,219	81.3%
New London, CT	3,157,705	2,895,586	91.7%

*Includes Group 29 (Petroleum and Coal Products) and Commodity 1311 (Crude Petroleum)

Current Vessel Fleet Serving Fall River

The terminals at Fall River Harbor are currently served by a variety of vessels. Barges used range from 10,000 to 30,000 DWT with drafts from 15 feet to 34 feet. Tankers range from 24,000 DWT to 35,000 DWT with drafts of 32 feet to 36 feet. Due to the present 35-foot channel depth and the availability of larger vessels, the following inefficient practices are more the rule than the exception at Fall River: lightering, lightloading, transshipment and tidal delays. Table 8 shows that the ships with increasingly deeper drafts are making deliveries to Fall River. They utilize the tide and also are lightloaded and are engaged in transshipping.

Table 9, which summarizes the trends in traffic, shows that incoming trips to Fall River Harbor have increased by 22 percent over the past 10 years. The statistical mode of each year's distribution of ships by draft shows an increasing trend to the point where the largest possible ships are used with the tide allowance.

Table 8

Fall River Harbor

	Number of Inbound Trips	Statistical Mode of Vessel Draft
1979	1,892	35
1978	1,697	35
1977	1,557	35
1976		
1975	1,292	34
1974	1,508	33
1973	1,704	32
1972	1,577	32
1971	1,157	32
1970	1,249	31
1969	1,552	31

Table 9

Trends in Vessel Traffic
Fall River Harbor
(Inbound Only)

Draft (ft)	1979	1978	1977	1976	1975	1974	1973	1972	1971	1970	1969
38							1				
37		5		3	5	8	10	1			
36	7	21		13	21	23	21	11	1		
35	27	36	50		15	14	5	10	20	2	3
34	14	21	20		28	22	17	10	20	3	30
33	8	13	6		16	30	20	11	23	12	17
32	9	6	5		17	22	38	38	34	60	54
31	5	5	2		13	21	21	23	23	66	62
30	3	1	5		3	6	9	7	6	5	60
29	2	1	9		2	5	9	6	5	6	40
28	7	3	15		6	6	11	13	2	2	
27	2	2	18		5	5	3	6	6	3	40
26	8	8	5		2	11	7	7	2	2	20
25	9	12	4		1	7	6	8	2	2	20
24	18	10	15		11	11	7	7	9	16	60
23	9	6	15		8	8	7	4	12	6	17
22	5	6	5		6	6	6	11	11	14	29
21	3	4	4		4	4	2	8	3	6	80
20	14	9	2		1	6	3	4	4	7	70
19	24	3	6		1	6	3	4	4	7	70
18 & less	488	454	478		448	249	302	321	404	359	330
Tug/Tow	1,230	1,071	893		688	1,046	1,198	1,047	558	671	950
TOTAL	1,892	1,697	1,557		1,292	1,508	1,704	1,577	1,157	1,249	1,550

Water Quality

Mount Hope Bay has a water quality classification of S-A and S-B in Massachusetts and S-A, S-B, and S-C in Rhode Island. (See Figure 3) These classifications are used to determine what types of activity may take place in specific waters. For example, S-A is the highest classification for marine waters; these waters are considered suitable for the direct harvesting of shellfish for human consumption. The highest use of S-B waters is bathing; shellfish may be harvested, but they would require some form of purification. The highest use for S-C water is wildlife habitat. The actual conditions of the waters may not be as high as their classification -- classifications are considered goals to be achieved and not necessarily a reflection of present conditions.

Historically, the major sources of contamination for Mount Hope Bay have been from combined sewer outfalls, the sewerage treatment for Fall River, industries, and the Taunton River. There are 14 combined sewer outfalls discharging into the bay. When they become overloaded, raw sewage can discharge into the bay and those discharges can contain high levels of many contaminants in addition to bacteria and viruses. Fall River has a wastewater treatment plant discharging into the bay. The plant is located near the Massachusetts-Rhode Island boundary. It supplies primary treatment to the wastewater. The system is being upgraded to secondary treatment, but the new treatment process will not come on line until 1983.

Manufacturing companies have discharged heavy metals and toxic chemicals into the bay and into the Taunton River. These discharges have been reduced substantially. (See the latest testing results in the Environmental Consequences section of this EIS.)

Fishery Resources

Mount Hope Bay itself is an estuary that has the characteristic mixing of fresh and salt water; and is, therefore, an environment intermediate between two systems. Like most such systems, species from both fresh water and salt water use these areas, but the species of major concern in Mount Hope Bay is the quahog, a shellfish. This shellfish is found scattered throughout the bay; however, it is not found uniformly. Quahogs are not harvested from the bay itself because the Commonwealth of Massachusetts has classified the bay's waters as SB, and shellfish can only be harvested from such areas if they will be depurated after harvesting. However, quahoging is allowed without depuration in Cole River, a tribuatary to the bay, and a number of fishermen do harvest in this area. The quahog is essentially nonexistent in the channel itself (Rhode Island Marine Fisheries and Corps Survey, 1981 and Massachusetts Division of Marine Fisheries, 1980). Finfish are present in Mount Hope Bay. The two most abundant are the Atlantic menhaden and the winter flounder. Both of these species are commonly found along the coast in this area.

There are no known rare or endangered species found within Mount Hope Bay.

III. ALTERNATIVES INCLUDING THE PROPOSED ACTION

Introduction

When the Congress authorized the deepening of channels into Mount Hope Bay in 1968, the report evaluated the benefit to be derived from the approved plan. That plan included a provision for open water disposal based upon non-availability of viable or more economical alternatives. This action pre-dated both National Environmental Policy Act (NEPA, 1969) Marine Proection Research and Sanctuaries Act (Ocean Dumping Act, 1972) and the Federal Water Pollution Control Act of 1972.

An analysis of viable alternatives is a requirement of NEPA. The analyses made prior to 1968 and in the 1971 document are reviewed, and new information is brought to bear on the environmental consequences of the several alternative plans considered to be reasonable and practicable.

The selected option in the 1971 report was the Brenton Reef Dumping Ground, a square mile area established for the purpose of dumping material from the improvement of Providence Harbor, then in progress. In light of then existing water quality criteria, EPA in 1972 recommended disposal either on land or in a containment structure. Strong territorial views expressed by fishermen caused the State of Rhode Island to withhold sponsorship for the project, and a final impact statement was not prepared.

With passage of the Ocean Dumping Act, which included criteria for site selection and material acceptability, together with a joint Rhode Island-Massachusetts recommendation for an alternate site, a second draft EIS was issued in February 1976. The site recommended by the bi-state committee was named Brown's Ledge, located on a projection of the state boundary, and outside states' three mile limit. Opposition to the new site which was expressed by the fishing communities was echoed by Congressional representatives, and Massachusetts tentatively withdrew its support for the project. The Corps of Engineers continued to monitor the existing site at Brenton Reef under its routine program, and several special studies of disposal impacts were carried on.

Renewed interest in the project arose in 1980 with world wide concerns over oil supply and initiatives toward alternative fuels, chiefly coal. This environmental impact statement is therefore an updating of previous studies and presents an array of alternatives which should be considered in making a decision on the project. The preferred alternative described here is that which realizes the desired benefits in the most environmentally acceptable manner, in the judgment of the Corps of Engineers.

(1) No Action or continuing to maintain the navigation channel at 35 feet.

(2) Constructing an off-loading facility at the entrance channel to Mount Hope Bay and pipelines from the facility to the users.

(3) Dredging the Tiverton channel to 40 feet and then transshipping the commodities by rail or pipeline to Fall River.

(4) Dredging the existing channel to 40 feet below mean low water and disposal at Brenton Reef.

ALTERNATIVE 1

NO ACTION - EXISTING PROJECT

The existing project for Fall River Harbor, Massachusetts and Rhode Island was adopted 3 July 1930 and modified by the River and Harbor Acts of 24 July 1946 and 3 September 1954. It provides for a channel 35 feet deep and 400 feet wide, extending from deep water in Mount Hope Bay to the Globe Wharf at the mouth of the Taunton River. The channel continues at the same dimensions, increasing in width at the bends upstream to the Shell and Montaup wharves above the Brightman Street Bridge. A turning basin 35 feet deep, 1,100 feet wide and 850 feet long is provided at the upstream limit of the project. The existing project also provides for a separate channel 35 feet deep and 400 feet wide extending from deep water in Mount Hope Bay easterly to the vicinity of the Tiverton Shore from where it branches northerly and southerly along the Tiverton waterfront. The northerly limit is about opposite the Fuel Storage Corp. Terminal (formerly Gulf Oil Company wharf) and the southerly limit is deep water in Tiverton Lower Pool. Other provisions of the existing project include the removal of ledge at the lower end of Hog Island Shoal to a depth of 30 feet; maintenance of a 25-foot anchorage west of the upper harbor channel; and a channel 30 feet deep east of the main harbor channel in the area from the vicnity of the State Pier to just below Slades Ferry Bridge. The existing project, except for that portion calling for removal of the rock at the Hog Island Shoal, was completed in March 1959. Some shoaling is occurring in the existing project, however, and approximately 300,000 cubic yards of material is needed to be dredged.

The No Action Alternative would continue the existing conditions for those vessels using the Fall River harbor. Many vessels would lighter at other ports, would bring in less than full loads, and would experience tidal delays. This would result in an inefficient use of economic resources, and would cause the loss of about $3.6 million in annual benefits that could be derived from deepening the channel.

The environmental impacts associated with dredging and disposal would continue with this alternative, as the existing channel would still require maintenance dredging. Of course, the magnitude of the impacts would be less since maintenance dredging involves smaller quantities of mateial. The safety of the vessels using the harbor would not be as great as under the proposed alternative. The clearance between the vessel and the bottom would be less and this might lead to grounding, which could cause spillage of cargo.

This alternative does not meet the needs of the region nor does it forestall the environmental consequences of future accidents and lost productivity.

ALTERNATIVE 2

OFF-LOADING FACILITY IN MOUNT HOPE BAY

The route from Narragansett Sound to the entrance of Mount Hope Bay is more than 40 feet deep, and could be used by deep draft vessels. If an off-loading facility or island were to be constructed in the deep water in Mount Hope Bay in the vicinity of Mount Hope bridge and the incoming products could be pumped from the platform to the users, then dredging and disposal of the dredge sediments would not be required with the exception of some periodic maintenance. A similar alternative was evaluated by the Corps in the 1971 Draft EIS; however, it was determined that this alternative was less economical than deepening the existing channel. This alternative was reevaluated to determine if it is now viable.

Should such a facility be constructed in Mount Hope Bay, two pipelines would have to be laid -- one for petroleum products and the other for coal. Brayton Point Generating Station has converted three of its four generating units to burn coal. This coal would be pumped in a salt water slurry from the off-loading facility to Brayton Point, creating the problem of removing fine coal particles from the slurry water before it could be discharged back into the bay. Depending upon the settling time required to remove the coal particles, this could require that a substantial area of land be devoted to storage lagoons.

In 1974, Massport in Massachusetts estimated costs of an offshore unloading facility to serve Boston to be $41 million. At today's prices, that cost is close to $82 million.

While this price range far exceeds the cost of channel deepening, there are additional factors which would enter into consideration for investment decisions. Each company has an investment in unloading facilities and berths, together with land based equipment for product handling. The expense of replacing these faiclities with pipeline equipment would be evaluated individually against the savings to be realized from transportation by larger vessels.

As a private venture, it is unlikely that this would interest investors. Since this is not currently authorized as a Federal investment, it cannot be considered as a viable option to continued use of the existing channel, or its deepening.

The existing Federal navigation channel would still be maintained since commodities other than coal and petroleum are transported into Fall River. For example, there is a chemical company that has a number of ships delivering products to it each year, and the State Pier also has dry cargo unloaded at its facilities. For these and other users, the channel would still likely need to be maintained at its present depth of 35 feet.

ALTERNATIVE 3

OFF-LOADING AT TIVERTON, RHODE ISLAND

As described under Alternative 1 the existing Federal project provides for a channel 35 feet deep and 400 feet wide extending from deep water in Mount Hope Bay easterly to the vicinity of the Tiverton Shore from which it branches northerly and southerly along the Tiverton waterfront. The improvement project (Alternative 4) as authorized provides for deepening the existing channel to 40 feet and widening the bend leading into the channel to 600 feet.

Under Alternative 3 the Tiverton portions of the improvement project would be undertaken and with the berthing areas dredged to 40 feet it would then be possible to unload the products bound for Fall River from facilities served by the Tiverton channel. The products could then be transshipped by pipeline and rail to users in Fall River. This alternative would eliminate the need to deepen the Mount Hope Bay channel to 40 feet but continued maintenance dredging and disposal would be required with this alternative.

This alternative would add significantly to the transportation costs of the products transported from Tiverton to users supplied from Fall River. The two primary products shipped into Fall River are petroleum and coal. In 1981 approximately 8.8 million barrles of petroleum (2.6 billion pounds) and 3 million tons of coal were shipped into Fall River. In order to transship this quantity of product, extensive changes to existing and new land based facilities would be required. In addition to the significant capital outlay required, operation and maintenance costs would represent a sizeable annual outlay. If other products were to be transshipped in this manner costs would of course increase significantly.

Based on studies conducted in other areas of New England neither pipeline nor rail options come close to competing with the waterborne costs of transporting petroleum and coal cargos. It would be difficult to visualize an investment picture which would result in a favorable return under these conditions. This option, together with Alternative 2 were not projected beyond gross economics simply because of the large disparity in costs. Were there offsetting gains in reducting loss to fisheries or disruption of other vital areas of regional economics these would have been factored in. However, as this analysis indicates, that situation does not exist.

ALTERNATIVE 4

DREDGING THE EXISTING CHANNEL TO 40 FEET BELOW MEAN LOW WATER

The uncompleted modification for improvement dredging in Fall River Harbor, Massachusetts and Rhode Island was authorized by the River and Harbor Act of 13 August 1968 (P.L. 90-483). The project as authorized, modifies the existing project in accordance with the recommendations set forth in House Document 175, 90th Congress, 1st Session and provides for:

a. Deepening the existing 400-foot wide 35-foot deep Mount Hope Bay channel to 40 feet within the existing channel limits from deep water in Mount Hope Bay to and including the existing turning basin upriver of the bridges.

b. Deepening the existing 400-foot wide by 35-foot deep Tiverton channel to a depth of 40 feet to the vicinity of the Tiverton shore, thence upstream to the vicinity of the Fuel Storage Terminal and widening the bend leading into this channel to 600 feet.

c. Providing a channel 400 feet wide and 40 feet deep in Tiverton Lower Pool along the Tiverton waterfront to the vicinity of the Northeast Petroleum Corporation.

d. Altering the Brightman Street Bridge to provide for a clear channel width of 300 feet through the drawspan.

Construction of the entire improvement project would require dredging all 7.4 miles of the main ship channel into Fall River Harbor and the 3.2 mile long Tiverton channel in Rhode Island. Approximately 4.5 million cubic yards of ordinary material, exclusive of any required maintenance or material from berthing areas, would need to be dredged and disposed of and the Brightman Street Bridge relocated and or altered in order to complete the improvement project. At the present time any work on the Brightman Street Bridge is not anticipated to be accomplished before the end of the 1980's. As a result, this study is concentrating on that portion of the main ship channel starting in deep water in Mount Hope Bay and extending to a point 500 feet north of the Braga Bridge and all of the Tiverton channel.

Approximately 3.65 million cubic yards of ordinary material would need to be dredged to complete this portion of the improvement project. In addition approximately 0.3 million cubic yards of maintenance dredging and 0.85 million yards of material from adjoining berthing areas, discussed later, would need to be dredged.

In past Corps studies for this project, a number of channel depths were evaluated, including a 37, 38, 40, and 45 foot deep channel. The 40-foot channel was found to be the optimum depth for economic as well as safety reasons. The current economics for the project demonstrate that the 40-foot channel is economically justified, and the following analysis demonstrates the need for a 40-foot channel for improving the safety of these deep draft vessels using the harbor. Selection of channel depth is predicated on ship draft plus proper allowance for safe navigation. In this locality, a 5-foot clearance between the bottom of the hull and the channel bottom is considered necessary. The 5-foot clearance is composed of several factors which require consideration. These factors include squat or trim of vessels when underway; uneven loading, due in some cases to fuel consumption at the end of a long voyage and in others to the difficulties inherent in loading oils of different specific gravities in the same vessel; adequate hull and propeller clearance for steerageway; and the character of bottom materials.

Ships underway are subject to a condition known as squat. This condition results from the effects of a bow wave pushed up in front of the vessel underway. The hull of the vessel sinks in the following trough adding to the draft. For this channel, a maximum allowance of one foot was included for this factor. An allowance of 1 to 2 feet was made for uneven loading. In addition to these features some clearance between the channel bottom and the hull is necessary to avoid sucking of materials into the propeller and for adequate steering. The commonly accepted clearance requirements in this category for large vessels are 2 to 3 feet, minimum. The sum of these factors indicates a 5-foot clearance is necessary for all vessels. Channel depth selection and inclusion of tidal amplitudes are included in this 5-foot factor.

The undertaking of the Fall River improvement project would result in a number of consequences. These would be both economic and environmental. The major economic benefit would result from the ability of larger vessels to efficiently and safely use the waterway, substantially lowering the cost of delivered products. For example, in the waterborne petroleum trade, per-ton delivery costs for the commodity become proportionally lower as the size of the vessel increases. The per-ton delivery cost for a 25,000 dead weight ton vessel is 0.076¢, but for a 50,000 dead weight ton vessel the cost is 0.048¢. Therefore, if larger vessels are used, the transportation costs become substantially lower. Increasing the depth of the channel would allow this to occur. The economic analysis illustrates that improving the Tiverton Channel would result in a favorable return on the investment with a benefit-cost ratio of 5.4 to 1, while in the main channel the benefit-cost ratio would be 3.5 to 1.

The environmental consequences in the vicinity of the project would be the possible loss of benthic organisms in the channel, the creation of turbidity (suspended sediments), and the possible release of contaminants from the sediments during dredging.

The channel is essentially devoid of biological life because channels act as settling basins for fine grained materials, and during each tide some of this fine grained material is re-suspended into the water. The concentrations of sediment and water can be as high as 40 percent solids and 60 percent water. Most bottom inhabiting organisms are unable to cope with this high a concentration of solids.

Benthic organisms can be found along the channel edges, and the one that might be of concern in Mount Hope Bay is the quahaug. As the channel in the bay is deepened, the side slopes would slump down into the channel bringing a portion of the channel edge down with it. Any quahaugs on these edges would be either dredged up with the sediments or would remain in a habitat now unsuitable for it. The analysis presented in the Environmental Consequences section shows that the loss of quahaugs would be equal to about 433 bushels of clams. This would not be a significant impact on the total population of quahaugs found in Mount Hope Bay.

Turbidity would also be created at the dredge site. The scientific literature pertaining to dredge site turbidity shows that the concentrations are normally about 100 parts per million, (ppm) but in unusual circumstances the concentrations can reach 500 ppm. The studies conducted on mortalities due to turbidity show that most organisms can survive at 500 ppm with little adverse impacts. This is also true for the eggs and larvae of most species that would be present in the bay. Therefore, the creation of turbidity at the dredge site would not have a significant impact on most organisms.

One of the procedures used to determine the release of contaminants during dredging is the elutriate test. In this test, sediments and water are mixed together and agitated for 30 minutes. The water is tested to determine if any chemicals were released in the water, and then the results are compared to EPA's water quality criteria and the ambient water concentration for the area. The Fall River test results indicate that during dredging there should be little or no release of chemicals into the surrounding water at the dredging site.

Economic Benefits Attributable to Improvement

Improvement of Fall River Harbor would enable the market area to realize considerable economic benefits during the project life. These benefits are derived from savings in the cost of transporting waterborne commerce with the improvements versus the existing conditions. The terminals would be able to receive their products in larger capacity vessels which are more cost effective. In addition, the costly and inefficient practices of lightering, lightloading and transshipment would be reduced or eliminated. The ultimate beneficiaries of these savings would be the consumers of these products in the tributary area. The discussion below focuses on the regional beneficiary population (mainly Rhode Island and Massachusetts) and the linkages between the terminal and consumption of final product.

To fully determine the magnitude of the beneficial effects of the project savings requires delineation of the actual and immediate tributary areas. The immediate tributary area is the city of Fall River and nearby surrounding towns where the industrial, commercial and residential entities initially utilize the petroleum products received at the harbor terminals. The actual or true tributary area is the one in which final consumption of the products occurs and the benefits reach full realization. The actual tributary area for this project is an irregularly shaped geographical area whose parts extend out from Fall River and encompass a population of over 1 million people. The size of this area and location of the final beneficiaries is due to the following factors:

- The Shell Oil Co. owns and operates two 6 inch pipelines which eminate from their facility above the Brightman St. Bridge. One pipeline terminates at a tank farm in West Boylston, Mass., just north of Worcester, and serves central Mass. and parts of southern N.H. and southern Vt. The second pipeline runs to a tank facility in Waltham, Mass., which serves a large portion of metropolitan Boston.

- The Montaup Electric Co. generates electricity from its facility above the Brightman St. Bridge for the following markets: greater Fall River, Brockton, Middleboro, Blackstone Valley Electric, Woonsocket, Newport and Pascoag, R.I.

- The New England Power Company's Brayton Point Station has a generating capacity of 1,615,000 kilowatts and handles a significant share of New England's energy needs. The facility serves Rhode Island, Narragansett Electric, Mass. Electric and Granite State for a total of about one million customers.

- The Borden and Remington Co., primarily a dealer in chemicals, has the largest caustic soda terminal in the northeast U.S. and markets in all of southern New England up to southern New Hampshire and Maine. In addition, they import large amounts of latex annually to supply the related industries.

- The Algonquin Synthetic Natural Gas Co. is the only supplier of SNG in the southern tier of New England. It serves the winter peaking demands of Boston Gas and also supplies Providence, Fall River, Brockton/Taunton Cape Cod and New Bedford.

- In the Tiverton, Rhode Island portion of the project are located tank facilities which supply local wholesale and retail markets with motor fuel and home heating oil.

Of the 17 major (deep draft) harbors in New England Fall River ranks seventh in terms of total tonnage of waterborne commerce. Primarily a receiving port (96 percent receipts), petroleum products account for 98.9 percent of all tonnage received. Over the past 20 years total tonnage of waterborne commerce at Fall River has more than doubled.

Year	Total Commerce (short tons)
1979	4,798,674
1969	4,261,327
1959	2,174,230

In order to measure the gains in navigational efficiency with the 40' deep channel versus the existing condition (35'), it was necessary to project future levels of waterborne commerce at Fall River. The New England Division had previously retained Resource Planning Associates, Inc. to project future shipments of petroleum products through the 17 major New England ports, including Fall River. Based on U.S. Dept. of Energy, Energy Information Administration estimates and energy-use coefficients developed for specific product consumption, future waterborne shipments by petroleum product type were projected for the years 1985, 1990 and 1995. A second and equally important source of projects was interviews with the terminal operators who factored actual industry knowledge into their estimates. The projections in the table below are aggregates of: residual, distillate, gasoline, naptha, jet fuel and coal.

Year	Quantity (in short tons)
1979 (actual)	4,745,439
1985	6,196,931
1990	6,558,052
1995	7,016,734

The second component necessary for the measurement of navigational efficiency is the makeup of the fleet which will transport the future tonnages of product. Waterborne Commerce Statistics indicate that Fall River Harbor is currently served by tankers in the range of 24,000 to 35,000 DWT with drafts of 30 to 35 feet. Barges used range from 10,000 to 30,000 DWT with 15 to 34 foot drafts. Due to the 35' channel depth limitations the following are practiced at Fall River: lightering, lightloading and transshipment. Tidal delays are also encountered. The following table displays the trend in vessel trips and loaded draft over recent experience.

Year	Number of Inbound Trips	Statistical Mode of Vessel Draft (tanker)
1979	1,892	35
1974	1,508	33
1970	1,249	31

Currently the channel is being utilized, with the tide, to its maximum practical extent. After consulting terminal operators and available future fleet studies, the following fleet mixes were projected for Fall River Harbor with a 40' channel. Due to existing contracts, arrangements, and vessel availability, the fleet will not adjust instantaneouly to the deeper channel but will do so over a period of years after project implementation.

Year	Projected Tanker Fleet in DWT
1979 (actual)	24,000-35,000 DWT
1985	50% 30,000-35,000 DWT 50% 50,000 DWT
1990	33% 35,000 DWT 66% 50,000 DWT
1995	100% 50,000 DWT

Average annual benefits for the entire Fall River Harbor project amount to $14,569,100 based on 1981 vessel operating costs, a 50 year project life and the 3-1/4 percent interest rate specified in the authorizing legislation. At the current Federal interest rate for evaluating water resource projects, 7-5/8 percent, benefits amount to $14,015,800. The benefits are based on increases in navigational efficiency and measured as savings in transportation costs. The quantities of petroleum products to be received by the terminals were projected over the 50 year project life as were the type and size of vessels designated to deliver the products. The savings were calculated by comparing costs to deliver the projected tonnage under the existing condition (35 foot depth) versus the improved depth of 40 feet. The benefits were estimated independently for each of the four components of the overall Fall River Harbor project and are displayed in Table 10.

Table 10

Average Annual Benefits - Improvement Project

Component	Annual Benefit 3-1/4%	Annual Benefit 7-5/8%
Tiverton Channel	$ 2,612,300	$ 2,371,600
Main Channel - below Brightman St. Bridge	1,959,300	1,959,300
Main Channel - above Brightman St. Bridge	2,533,500	2,361,000
Brightman St. Bridge Alteration	7,464,000	7,323,900
TOTAL	$14,569,100	$14,015,800

The economic benefits which accrue to the 40' channel are based on the ability to navigate the waterway with larger vessels than are currently in use. In the waterborne petroleum trade, per-ton delivery costs of commodities become proportionally less as the size of the carrier increases. Transportation costs are based on the hourly operating costs of vessels while at sea and in port. Table 11 shows the latest available operating cost of specific U.S. flag vessels at sea as derived from published data. The table illustrates how the hourly per-ton delivery cost decreases as vessel deadweight tonnage increases.

Table 11

Operating Costs - 1981
U.S. Flag Vessels - At Sea
(in dollars per hour)

DWT	Hourly Cost - At Sea	Per Ton
25,000	$1,900	.076
35,000	2,060	.059
50,000	2,410	.048
60,000	2,860	.047

Benefits were estimated independently for each of the four components of the overall Fall River Plan.

- Tiverton

Petroleum products are currently delivered to the three Tiverton, R.I. terminals (Texaco, Northeast and Fuel Storage) in vessels ranging from 25,000 to 35,000 DWT. Lightloading, lightering and transshipment are involved in current operations. The products, motor fuel and home heating oil could be brought in by 50,000 DWT vessels with the 40-foot deep improved channel. Allowing for a period of adjustment to the larger vessels by the terminals, it was estimated that annual benefits of $2,612,300 would accrue to Tiverton channel improvement over the 50-year project life.

- Main Channel - below Brightman St. Bridge

There are two users in this portion of the channel, Borden & Remington Industries and New England Power Co., with the major user being New England Power Co. at Brayton Point. Three of the four generating units have been converted to coal, but unit #4 still burns a substantial amount of oil annually. Benefits were estimated separately for oil ($1,495,000) and coal ($464,000). The project would enable the use of larger vessels, reduce or eliminate lightering and reduce tidal delays, resulting in $1,959,000 annual benefits. There is a potential for another channel user to be added in the mid to late 1980s. EG&G Synfuels Corp. is planning a coal gasification facility to be located in Fall River and has identified a site (Penn Central yard) as a coal offloading and transfer point.

- Main Channel - above Brightman St. Bridge

The three users in this segment are Montaup Electric, Shell Oil and Algonquin Synthetic Natural Gas. All currently barge most of the products received with some 25,000 DWT tankers also used. This is due to the inadequate horizontal clearance at the Brightman St. Bridge. Products received are Shell-gasoline, furnace oil, jet fuel and asphalt, Montaup - #6 oil, and Algonquin naptha. Benefits to the 40-foot deep channel with a modified bridge are estimated to be $2,533,500 annually.

- Brightman St. Bridge Alteration

The inadequate horizontal clearance of 98' restricts the size of ships that can use the upper channel. Tankers are limited to the 25,000 DWT size and most of the traffic is barges. If the bridge were altered the existing 35' deep channel above the bridge could be fully utilized by larger vessels, resulting in annual benefits of $7,316,300.

Related Permit and Dredging/Disposal Actions

The improvement of the Mount Hope Bay channels would be attended by improvements in berthing facilities of the terminals being serviced.

In addition, the availability of a disposal site within economical haul distance may result in applications for dredging and disposal from facilities located in Providence Harbor and other facilities in the Narragansett-Mount Hope Bay regionas. The needs of Rhode Island are documented in a study by the Coastal Resources Center at URI (January 1931).

The present estimate of dredging for those private companies in Mount Hope Bay is:

Tiverton Channel Area	Volume CY
Northeast Petroleum	23,500
Texaco	35,000
Fuel Storage Corporation	15,000
Tiverton Volume	73,500

Fall River Channel Area

New England Power Co.	750,000
Borden and Remington Corp.	23,500
Fall River Volume	773,500

A technical evaluation of Fall River (Taunton River and Mount Hope Bay) bioassay/bioaccumulation test data, which is included in this Environmental Impact Statement, has determined that the proposed dredged material is in compliance with the Ocean Dumping (103) Criteria and that the material is acceptable for disposal at the Brenton Reef site. Concurrence with this determination will be sought from the Environmental Protection Agency during the Environmental Impact Statement review process.

An inclosed plate Figure 1 shows an area, inside of which authorization for private dredging with ocean disposal is considered acceptable due to the close proximity and similarity of the work. An investigation of historic and present uses of the area indicate that there are no significant point source discharges and that the area within the envelope is considered similar in nature. All the private berthing projects are within this envelope and abut the proposed Federal channel.

All private dredging applicants must obtain the necessary State license, water quality certification and local approval prior to receipt of Department of the Army authorization.

The 1981 University of Rhode Island Dredging Needs Survey indicates that the five year needs of Rhode Island totals about 800,000 cubic yards requiring ocean disposal. Half of this volume is from new or improvement projects. There are no known other requirements outside this region which would affect the disposal area requirement within that five year period.

These disposal operations could be conducted with a management plan similar to that currently in use in Long Island Sound, but oriented to the existing fishery within the dumping ground. The objective of that management plan would be to sustain the maximum yield over the portion of the square mile which is not in use. The portion involved in dumping (about one/half) would be managed by regulating disposal of sediments in a manner which results in a substrate of a quality which is most conductive to colonization by biota, and enhances overall productivity.

Thus, the dumping activity at the site projected over a five year span would be pictured as continuous for the period of the Mount Hope Bay and terminal improvements, a span of about three years. Other work would tend to be sporadic and of short duration, but concentrated, nevertheless, within a distinct portion of the site. The present monitoring program over the entire square mile and boundaries would continue.

Disposal Options

The alternative of deepening the existing channel in Fall River to 40-feet below mean low water under the first contract described earlier would mean that about 4.8 million cubic yards of dredged material would need to be disposed of (including expected permit actions). There are three possible options for disposing of the sediments: at an upland site, at a shallow water site within or adjacent to the bay, or at an open water site. The feasibility of each option is evaluated in the following paragraphs.

Upland

The New England River Basins Commission, under contract to the Corps of Engineers, prepared a report (NERBC, 1981) on potential upland and shallow water disposal sites for dredged material from Narragansett Bay. At the request of the Corps, the commission prepared a site selection supplement report dealing with upland disposal for the Fall River Harbor Improvement Project.

The site selection method used by the commission was to eliminate unsuitable sites on the first screening and then suggest areas where detailed field investigations should be done. The screening process used the following absolute constraint criteria to eliminate unacceptable sites:

1. areas beyond reasonable transport distance;

2. protected preserves or refuges;

3. areas with critical or unique environmental or cultural value;

4. areas with adverse physical condition (water sites only); and

5. areas with existing land uses that are incompatible with dredged material disposal.

The NERBC study identified 59 upland areas as having the potential for use as disposal sites. (See Figure 4.) However, the Commission's study team did not conduct field investigations, determine land ownership, or contact local authorities regarding specific sites.

For a site to be acceptable for upland disposal it must contain a minimum of 100 acres, it must be accessible, and it must have a minimum of physical constraints.

The minimum size of 100 acres was determined by using the following analysis.

If upland disposal is to be considered for Fall River, the following must be determined:

1) the total number of acres required to accommodate the sediments, and

2) the minimum area necessary for an individual disposal site.

The improvement dredging of Fall River under the first contract would require removing approximately 4.8 million cubic yards of sediments. One acre can accommodate about 1,600 c.y. of dredged material to a depth of 1 foot. Assuming the sediments would be piled 7 feet high, 1 acre could accommodate 11,200 c.y. This figure divided into the 4.8 million c.y. gives the number of acres needed -- in this case about 420 acres. However, there would also be a need for diking and right-of-ways to work on the dikes which would add at least an additional 26 acres. Therefore, the total area needed for disposing of 4.8 million c.y. would be about 450 acres. We have assumed that the disposal site is square, that the site is flat, and that the dikes could be constructed with 1 on 2 slope. Deviations from this ideal could increase the total area needed.

A hydraulic dredge pumping to an upland site could move about 35,000 to 40,000 c.y. of sediment per day. But along with the sediments it also pumps a substantial amount of water. The water in the slurry generally accounts for 80 to 90 percent of that found in the pipeline. Again for simplicity sake, if we assume that 40,000 c.y. of sediment is pumped per day and we know that this is only 20 percent of the total being pumped, it follows that 160,000 c.y. of water would be pumped with the sediment, the total amount being 200,000 c.y.

Using the previously developed figure of 11,200 c.y./acre, we can determine the area needed for one day's pumping of water and sediment, approximately 18-acres. The slurry water may or may not discharge quickly. It would depend upon how much suspended material would be present in the water to be discharged. But to allow for this contingency and to reduce the mobilization and demobilization process for equipment, the minimum area required would be five to six times the minimum size or approximately 90 to 108 acres. This does not take into account the area that would be needed for diking. It seems fairly clear that 100 acres would be the minimum area needed for any upland disposal.

It was determined that of the 59 sites identified by the NERBC study only one could be considered suitable for disposal. However, this site is relatively small -- about 20 acres -- and is substantially below the minimum 100 acres necessary for upland disposal. Further, this site is owned by Montaug Electric Company and the company has plans to develop the site in the future and will not make it available for disposal purposes.

The other 58 sites are unacceptable as disposal options for several reasons. Among these are:

1) The area where many of the sites are located is made up of very steep terrain. This would necessitate the construction of extremely high dikes to contain the sediments.

2) Many of the sites are inaccessible from the harbor and would require the use of routes that would cross major streets and arteries as well as high density commercial and residential areas.

3) Many of the sites are heavily wooded and would have to be cleared before dikes could be constructed to contain the dredged sediments. This would cause a loss of greenspace currently used for farming, recreation and forestry.

In the public workshops held on the Fall River proposal held in July 1981 there was general (although not universal) agreement among the participants that upland disposal was not a practicable alternative. Upland disposal therefore is not considered a viable option for the Fall River project.

Shallow Water Disposal Options

Research was made of available records to determine where dredged material was deposited during the various stages of improvement and maintenance of the Fall River Harbor Project. Three large improvement dredging projects have been carried out in Mount Hope Bay. In all cases, spoil was disposed of within the Narragansett Bay-Mount Hope Bay system. A precondition for Federal support of dredging through 1946 was that local interests furnish suitable disposal areas.

The first project involving large spoil volumes (2.5 million cubic yards) was proposed in 1927 (HD 158). Spoil was removed by bucket dredge and disposed of in the "Public disposal ground" east of Prudence Island in Narragansett Bay.

Records indicate that the east side of Town Pond and areas at Common Fence Point, both located in Portsmouth, Rhode Island, were used for disposal when the 35-foot channel leading into Tiverton, Rhode Island was dredged in 1949. The total estimated quantities of material removed amounted to 2,710,000 cubic yards plus an estimated 390,000 c.y. maximum allowable overdepth dredging. Spoil disposal areas were furnished by local interests as follows:

- Spar Island Disposal Area - Spar Island and the waters surrounding the island. The initial disposal was required to be concentrated as closely to the island as practicable. No material would be deposited more than 250 feet west of the island, nor more than 2,500 feet from the island in any other direction.

* Brayton Point and Lee River Area - The disposal site was the lowlands northwest and northeast of Brayton Point.

* Somerset Shipyard Area - Area above and below mean high water in the vicinity of the Shipyard.

* Area Vicinity Shell Oil Company - The cove south of and adjacent to the oil company property.

* Country Club Area - On lowlands on the shore of the Fall River Country Club.

Although the above areas were designated as dredged material disposal sites, there is no record available to indicate if all of the material was deposited at these sites since a clause in the specifications permitted the contractor to furnish alternate dumping grounds either before or after award of the contract, subject to approval of the Contracting Officer.

The project carried out between 1949-1951 involved approximately 5 million cubic yards. At this time, the Rhode Island State Government was concerned that the Narragansett Bay Ground was nearing capacity. Hydraulic dredging was used to pump spoil to an unconfined site adjacent to Spar Island in the center of Mount Hope Bay. A later report (HD 405) states that shellfishermen protested the use of this area but that the protests were rejected by the State of Rhode Island and the town of Tiverton.

When the main ship channel was dredged in 1950, there were areas where the contractor could not reach grade due to the presence of hard material. A contract was awarded in May 1954 to remove these obstructions at an estimated cost of $97,078. The contractor was permitted to deposit the material in nearby areas of the channel where natural depths exceeded 40 feet.

Dredging carried out in 1957-1958 involved 1.8 million cubic yards. It was reported that undesirable displacement had taken place at the Spar Island site and hydraulic dredging was used to deposit material on Common Fence Point on the northern tip of Aquidneck Island.

In 1959 a contract was awarded to remove unclassified material (including boulders and possible ledge rock) from the 35-foot entrance channel and the 35-foot area in Tiverton Pool. The material was to be transported and deposited in the East Passage of Narragansett Bay south of a line joining the southernmost points of Prudence Island and Dyer Island in depths exceeding 12 fathoms at mean low water.

In July 1962 specifications were issued to remove 388,000 cubic yards of material as part of the FY 1963 maintenance program. The designated disposal site was located in the East Passage of Narragansett Bay south of a line between Prudence Island and Dyer Island in depths greater than 12 fathoms.

A contract was awarded in 1973 to remove an obstructive shoal in the vicinity of the site of the former Slades Ferry Bridge. The material consisted of organic silt, sand, gravel, glacial till, boulders and debris from the bridge pier. The excavated material was transported by scow and deposited on land owned by the U.S. Massachusetts Memorial Committee, Inc. located in Battleship Cove, Fall River, to the east of the Battleship along Frontage Road north of the Quequechan River.

In the 1976 Draft EIS, a number of shallow water disposal options were evaluated for the Fall River project. The options included disposal at Spar Island, marsh creation, and fast land creation. These were found to be unacceptable options for this project; however, they are re-evaluated in this EIS and discussed in the following paragraphs.

In addition, disposal options suggested at the July 1981 Public Meeting; as well as the shallow water options developed by the New England River Basin Commission in 1981, were reviewed. None of these disposal options were found acceptable since at all locations a large area of shallow water habitat would be lost, suspended sediments would be dispersed over the bay and erosion of the disposal piles would occur during storms.

Spar Island Disposal

Spar Island is the only island within Mount Hope Bay. At mean low water approximately 3 acres of the island are exposed. At mean high tide it is approximately 900 feet long and ranges in width from 1.0 to 50.0 feet. The town of Bristol, Rhode Island, claims the ownership of the island based on the 1600 AD charter under which it was incorporated.

The Spar Island area has been used in past for disposal of dredge material (mainly consisting of sand and gravel) from adjacent channels. Samples taken from the channel sediments to be dredged indicate the material to be silty clay. Since the materials are fine grained their unconfined disposal is not feasible since they have a tendency to remain suspended and would spread out over a large area. Disposal options at Spar Island therefore have focused on development of a containment facility at the site.

One boring and six probes were made in the Spar Island area in October 1975 to determine the suitability of the overburden material for construction of a containment structure. Results of these explorations indicated that the overburden materials consist of approximately 8 to 20 feet of soft organic silt and organic clayey silt which overlie moderately stiff silty clay to an undetermined depth. The bottom elevation of the soft organic silt and organic clayey silt at the locations of the explorations varied from approximately -22' to -35' mean low water.

Due to the fact the soft foundation materials are unsuitable to support a rubble-mound dike structure, engineering studies have concentrated on the design of a double wall bin type steel sheet pile container.

As a basis for evaluating the feasibility,[1] both from an engineering and economic standpoint, of constructing a containment structure, we used a conservative model. Foundation conditions at the site leave the option of diking under extremely conservative criteria, or building a steel sheet pile structure. The latter was selected for evaluation because it is more conserving of space and would require fewer total resources, though at the expense of a shorter life. It does provide, nonetheless, some estimate of what investment would be required.

The proposed container would have a diameter of approximately 3,400 feet, a top elevation of 7 feet above mean low water, and an outside periphery of about 10,500 linear feet. The structure would consist of 1,000 bin units connected together by steel pile connectors bolted or welded to the bins. Each bin would consist of prefabricated steel sheeting measuring 10 feet by 16.5 feet by 40 feet and sunk in place. The structure is designed to withstand a 6-foot ware, which is the maximum size that could reach the site across the limited fetch in Mount Hope Bay. Following placement, each bin would be filled with sand to the top elevation of the structure. The current estimated cost of construction of this structure based on the preliminary design is approximately $19 million.

This cost is exclusive of dredging, and because there is no provision in law for assumption by the Federal government, the funding would be a local or state responsibility. While the cost of pipeline dredging is usually less than bucket and scow, the economies are achieved through higher production rates. In evaluating a container-type disposal situation, the most obvious limitation becomes the capacity, which in turn limits the rate of pipeline dredge production. Thus, it is conceivable that given the low pumping rates dictated by limited capacity of the container, together with the long pumping distance involved, the cost of pipeline dredging would not compare favorably with the bucket and scow dump method. The Corps estimate for dredging 3.65 million cubic yards by the pipeline method is $27,255,000. (See Table 12)

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[1] Currently a study on a preliminary design of a containment facility at Spar Island is being conducted under sponsorship of the New England Governors Council and its results are expected later this summer. In addition Rhode Island has underway an analysis of the legal implication of ownership if such a facility were constructed. This investigation will also be available in late summer.

Projecting beyond the one-time use scenario, the resulting container would require some treatment under a long range management plan. The major obstacle to determining whether the island would have any positive attributes stems from the fact that it has a constituency which argues for its use as an alternative to ocean disposal, but it has no sponsor. Without a distinct plan for ownership, aesthetic treatment, and projected utilization, the Spar Island alternative is an unlikely candidate for public acceptance as a viable alternative.

Organisms directly under the major portions of the piled sediments would be lost; those on the periphery of the pile may or may not be lost depending upon their ability to extricate themselves. The intertidal and subtidal areas would likely be repopulated by adjacent areas. Consequently, the impact would be short term.

There should be no significant release of contaminants at the site. The elutriate test results show very little release. Also, there should be no significant long term release of contaminants, because estuarine sediments are primarily sinks and not sources for most constituents and the sediments would remain in the estuary.

Marsh Creation

The creation of islands and marsh land with dredged material has received considerable attention in recent years. Benefits of such projects include the recovery of value from dredge spoil, the replacement or addition of marsh land which has aesthetic and productive value, and the elimination of interferences with offshore fisheries.

The properties of Mount Hope Bay dredge material make it unsuitable for most types of land disposal. Steel bulkheaded enclosures are expensive and displeasing to the eye. The construction of low islands or coastal lowlands stabilized with marsh grasses offers a technique which may be less expensive than distant ocean disposal and contribute to the area's natural resources by providing nursery grounds for fish and sources of detrital food. In recent years, techniques for planting spoil banks have been developed along the south east Atlantic and the Gulf Coasts where most dredging is carried out by hydraulic means. This material is usually not contained. The Waterway Experiment Station (WES) of the Corps of Engineers is currently supporting research and demonstration projects on marsh construction throughout the country. Marsh creation would result in a number of beneficial effects - new habitat would be created, detritus from the marsh would be washed into the bay where mirofauna could utilize the nutrients, and the marsh would create edge between itself, upland and the open bay. On the other hand, the adverse consequences associated with this proposal would include the loss of a large area of shallow water habitat in the bay. The total area covered would likely be between 400 and 500 acres, similar to the total area required for upland disposal.

There are no areas that can be recommended for marsh development along the shores of Mount Hope Bay. Housing, marsh, and beach areas in the Cole River and Lee River areas are well integrated and any development would be considered deleterious by residents. The east shore has a straight shoreline with large tracts protected from development by private owners while the Fall River shoreline is closely bordered by a shipping channel.

Land Creation

At the July 1981 workshop on the Fall River project, three locations were suggested as possible candidate sites for the creation of land. The land created would be used as commercial and industrial property. The sediments to be dredged from the harbor are almost totally fine silts and clays. An evaluation by Corps engineers determined that this type of material is unsuitable foundation material and should not be used for industrial and commercial property, and that this option, therefore, should not be considered a viable option for the Fall River project.

Open Water Disposal Options

Open water disposal options shown on Figure 5 were considered in the 1971 and 1976 Draft Environmental Impact Statements and most recently discussed at the July 1981 workshops. During the July meetings eight sites were presented and discussed; four sites located adjacent to Block Island are extensively fished and would not be acceptable to the fishing community. Further, these sites have never been utilized for the disposal of dredged sediments. The two sites in Buzzards Bay were considered too shallow. The remaining sites identified at that meeting and previously identified sites: Browns Ledge, Summerhayes, Acid Barge, Munitions and Brenton Reef, are discussed in the following paragraphs. Cost estimates are given in Table 12.

Table 12

Project Costs with Various Disposal Locations

(1982 P.L.) Federal Share First Cost for Contract 1	Brenton Reef	Browns Ledge	Acid* Barge	Ammo* Dump	Spar Island
Mt. Hope Bay Channel 500' Abv. Braca Bridge 1,950,000 cy	12,300,000	13,350,000	15,130,000	17,345,000	14,555,000
Tiverton Chan. 1,700,000 cy	10,700,000	12,150,000	14,230,000	17,013,000	12,700,000
Total First Cost	23,000,000	25,650,000	29,360,000	34,358,000	27,255,000
Federal Annual Charges					
Mt. Hope Bay Channel 500' Abv. Braca Bridge	542,000	589,000	661,200	758,800	641,000
Tiverton Chan.	485,000	547,500	640,200	766,300	574,000
Total Annual Charges	1,027,000	1,136,500	1,301,400	1,525,100	1,215,000
Non-Federal First Cost					
Berth Dredging	5,180,000	5,850,000	6,838,000	8,184,400	6,400,000
Container	-	-	-	-	19,000,000
TOTAL					25,400,000

*These figures do not reflect interest during construction.

Browns Ledge

The Browns Ledge site is located 37 miles from Mount Hope Bay. (See Figure 5. See 1976 DEIS for further details.) The center coordinates for this site are 41° 18.3' north, 71° 04.1' west. The total area of the site is one square nautical mile, and the depth of the water ranges from 100 to 120 feet. The sediments found at the site range from gravel to silt, but the site is predominately sand and gravel with a small portion containing silt and clay. The 1976 Draft EIS proposed the use of this site for the Fall River project, but its use was strongly opposed. The opposition centered about impacts to fisheries and the fact that this area has never been used for the disposal of dredged sediments.

The major species of interest at the Browns Ledge site are commercial fish and shellfish. Ocean quahogs are abundant in the area. Although they are commercially important species they are not commercially harvested at this site.

Lobstering is an important fishery in and around the disposal site. The rough bottom found in the area provides good lobster habitat. Most of the lobster boats operate out of Sakonnet, Rhode Island and Westport, Massachusetts, with about 10 to 12 boats using the general area. Lobstering is conducted throughout the year, but the most intensive fishing takes place between April and August. Pots are set in trawls with each boat setting out from 100 to 200 pots. The number of boats using the general area around Browns Ledge has increased compared to the past. The catch rate is considered moderate for these waters.

Otter trawling (dragging) is an active year-round fishery over the soft bottom found south of the proposed disposal site. Trawlers from Point Judith and Newport, Rhode Island as well as boats out of New Bedford, Massachusetts fish the area for yellowtail flounder, whiting, and butterfish. There is also a fall fishery east of the disposal site for fluke, scup, butterfish and flounders. The rough bottom found at the site makes trawling difficult in the area.

There is some line trawling and gill netting conducted in the general location. Purse seining and mid-water trawling are also occasionally done in the general area, but neither would be considered a major fishery. Browns Ledge itself is a popular sportfishing area with bluefish and stripers being the species most often sought.

The environmental impacts associated with disposal at the Browns Ledge site would be very similar to those presented later for the Brenton Reef disposal site. There would likely be burial of ocean quahogs and lobster. The "worst case" analysis presented in the Environmental Consequences section reveals that over 8,700 bushels of ocean quahogs might be buried, and that this would be a permanent loss for the foreseeable future. The maximum potential loss of lobster would be the same as for Brenton Reef, about 405,000 animals. However, there would not be a permanent loss of lobster habitat, and the population should return to pre-disposal levels or greater within a few years. Any turbidity clouds generated during disposal should have a short life, and should cause few if any problems at or near the site. There would likely be some erosion of sediments from the disposal area; this would likely settle out in the deeper waters to the southeast and southwest.

The chemical impacts should be the same as those presented for Brenton Reef. There should be no significant toxicity from the sediment or from the chemicals released into the surrounding waters. The bio-accumulation of chemicals should be restricted to petroleum hydrocarbons, but this constituent is not food chain magnified, and should not cause significant ecological impact at or near the disposal site.

Impacts to commercial fisheries would be short term and restricted to the period of disposal and recolonization.

The use of this site would result in increased towing costs as compared to Brenton Reef. The project estimate shown on Table 12 is $25.6 million and the time necessary to finish the project would increase by about 3 months.

If the Brown's Ledge site were to be selected for disposal, a favorable analysis would be required under the Ocean Dumping criteria. Our existing information indicates that the site is generally similar in its physical properties to the more studied bottom surrounding Brenton Reef. The major distinctions being that it has not been previously used, and supports a more diverse fishery. The impact of establishing it as a dumping gound would be that of creating a physical feature which might impeded some types of fishing, and result in a longer towing distance.

The underlying question then has to be whether selecting a new site based entirely upon political boundary considerations outweighs the logic of continuing use of an existing dumping ground. Unless there were an overwhelming need to reserve more bottom for lobster habitat, there are few reasons that would justify the change. The question of which fishery is of more benefit is certainly not answerable within the context of this analysis.

In fact, the pure logic of disposal site selection, whether for this project, or any other, must follow the general lines that if a disposal site has been established, and hte adverse consequences of any change are greater than maintaining the status quo, it would be difficult to justify a new site.

Cultural Resources

Coordination with the State Historic Preservation Officer of the State of Rhode Island (Letter, 12 April 1982) indicates that there is the potential for archaeological impacts at this site, and a study would have to be undertaken to determine the exact impact if the Browns Ledge site were used.

Potential Site Southeast of Browns Ledge - Summerhayes Site

This site was first suggested in response to the 1976 Draft EIS for Fall River. Dr. Summerhayes, formerly of Woods Hole Oceanographic Institution, reviewed some preliminary data on the site. He concluded that because the area was in a deep trough it might be ideal for containing fine-grained sediments and winter storm waves would be less likely to affect the site. He recommended that the Corps explore the suitability of this site.

The site is located about 3 miles south of the Browns Ledge site. The area is a trough created by glacial moraine and the bottom of the trough is in about 140 feet of water. Project costs would be similar to those shown for Browns Ledge in Table 12.

This represents an effort begun in the Brown's Ledge investigation of trying to find the "ideal" alternative site. The feature Summerhayes describes may be one of several which would satisfy the optimal requirements for disposal. Whether the site would have overriding characteristics in terms of fisheries or other considerations has not been determined, since this effort was discontinued after the 1976 draft EIS. The information on which to base a decision, therefore, would have to be obtained, and the substantial time delay does not fit the current budget program nor does it meet the needs of the project sponsors.

Acid Barge Site

This site was evaluated in the 1976 Final Environmental Impact Statement for the Naval Submarine Base New London, Connecticut. The following information is excerpted from that document.

The Acid Barge site is located, about 65 miles from Mount Hope Bay. (See Figure 5.) The site is one square nautical mile in area, and is located 41° 02.5' north, 71° 29.8' west. The average depth is 148 feet and the bottom consists of clean, moderately coarse sand. There has been no disposal of dredged sediment at this site in the past, but an acid barge was sunk at this site in 1945.

The area is known to be a productive yellow tail flounder ground, and is actively fished. Other fish are also present in the area including cod, pollack, hake, Atlantic mackerel, Atlantic bonito, white marlin, and swordfish. It is not known if there are any shellfish in the area, but it is possible that ocean quahogs and surf clams are present. Lobsters are likely to be present in the area, but no estimate of the population can be made.

Little data is available on the site. Information would have to be generated to determine the site's suitability. The long hauling distance would increase the cost of the project as shown in Table 12 and extend its completion time. Further, since the area is fished heavily for flounder, the site would likely be opposed by fishermen.

Munitions Site

The information presented on this site is excerpted from the 1976 Final EIS on the Naval Submarine Base.

The Munitions site is about 80 miles towing distance from Mount Hope Bay, and is located at 40^{o} 45' north, 70^{o} 50.2' west. Because of its distance from the project it is the most expensive of the open water sites. The site is one nautical square mile in area with an average depth of 200 feet. It is estimated that the bottom sediments found in the area are from 25 to 50 percent silt and clay. The site has not been used for dredge sediment disposal. Commercial fishing has taken place in the area, but with the exception of yellowtail flounder, the catches were reported to be low. Lobsters are also reported in the area, but catches are low. Ocean quahogs and surf clams are also reported to be present.

As with Acid Barge site, little data is available, and the necessary information needed to designate the site would have to be generated. The extra haul distance adds significantly to costs and completion time.

Brenton Reef Disposal Site

The center of the Brenton Reef disposal site shown in Figure 5 is located at 41^{o} 23.4' north, 71^{o} 17.95' west, which places it within the territorial waters of Rhode Island. The area shown on charts is one nautical mile square. For regulatory purposes, this area is subject to the provisions of Section 103 of the Marine Protection, Research, and Sanctuaries Act (Ocean Dumping Act) and is also subject to the provisions of the State of Rhode Island's certification procedures under the Clean Water Act of 1977.

This site was not designated by EPA under provisions of 40 CFR 220-229 and thus falls within the discretion of the Division Engineer who is authorized to select sites in the absence of a designated site. Application of the site selection criteria to this location results in the following:

1. Its geographical location, is within a reasonable economic haul distance of Narragansett Bay and Mount Hope Bay. The depth of water at this location is 25 to 32 meters, placing it at least at the margin of influence of deep water wave effects. The topography of the bottom is that of a previously used disposal site in the northwest portion of the mile square area, and the remainder is generally level terrain.

2. The importance of this square mile to fisheries has been documented in several ways. Its present characteristics as a previously used site limit to some extent the trawling operations, but provide an active lobster fishery. Little definitive information is available on spawning, but studies during previous dumping tend to indicate little, if any, interference with fish passage in terms of commercial catches.

3. There is no possibility that the use of this site would adversely affect recreation beaches or other amenity areas.

4. The materials to be deposited are similar in their characteristics to previously deposited materials and would, under proper mangaement, be configured to the desired form.

5. The area has been under study or surveillance for a period of about 15 years and is readily accessible both to surface and subsurface explorations.

6. Observations on the history of use of this site have indicated no significant adverse imapcts attributable to the disposal of dredged material. As indicated above, trawling operations have been somewhat limited due to the presence of the disposal mound. This feature has enhanced the lobster fishery in the area by limiting interference with gear, and to some extent in providing habitat.

7. Several distinct reports on aspects of the site following disposal and monitoring information depict the site as a stable mound which persists as a broad, gently sloping feature consisting of gray dredge material covered with a layer of fine sand. The presence of this sand layer may be the result of winnowing of finer material or of sediment creep where the fine sand from the surrounding area is pushed up and over the mound. This is still a subject of some speculation among oceanographers. Past reports indicate that bottom drift rates in the site area vary from 0.1 to 3.5 cm/sec in a northwesterly direction while tidal currents of 25 cm/sec have been observed (Cook, 1966). These velocities do not appear to have significance in terms of erosion and movement based on continuing observations of the disposal area in Long Island Sound as well as Brenton Reef where cohesive sediments have been deposited.

8. The site was originally chosen on the basis of non-interference with navigation or other legitimiate uses of the ocean. Fisheries now extant on the site have developed from the period of previous cessation of use.

9. The ecology of the site has been a subject of study and is detailed in reports. It is generally characterized by a very large amphipod community with relatively low species diversity. The major fisheries in the immediate area are lobster and ocean pout. However, cod, scup, and herring are taken from the adjacent areas at different times of the year.

10. The expection is that site management would result in a condition that is similar to that which is now present following previous dumping events.

11. There have been no significant natural or cultural features identified after extensive investigation over this area.

The following analysis and discussion demonstrate why this site has been selected as the disposal area.

Between 1967 and 1971 nearly 10 million cubic yards of dredged sediments were deposited at this site. Most of the sediment came from the Providence River Improvement Dredging Project, but some of the material was taken from the Brayton Point entrance channel located in Mount Hope Bay, and small quantities also came from the entrance channel in Point Judith Harbor, Rhode Island. The depth of the water at the site varies from 110 feet over the natural bottom to 80 where dredged sediments have been dumped. There are also piles of dredged sediments outside the disposal site which may have been caused by short dumping.

The Brenton Reef site has been studied extensively over the years (Saila et al., 1968; Saila, et al., 1972; Boehn and Quinn, 1978; Disposal Area Monitoring System (DAMOS), 1979; and Morton and Paquette, 1981). The following information on the present condition of the site is taken from these studies.

Prior to disposal at the site, the bottom was predominately sand, and contained a large population of ocean quahogs that were commercially harvested. The impact of disposal on this fishery was severe and direct. A large population was buried, and fishing had to be curtailed around the edges of the area because some clams were killed by shallow burial or had foul smelling mud on their shells. The greatest problem arose southwest of the site where the Providence Harbor dredge sediments had been deposited at temporary sites. Ocean quahogs processers have requested the fishermen to avoid the disposal area. The fishery is now carried out north and northeast of the disposal site at depths of less than 30 meters. The bottom in this area is sandy and yields a higher quality product (DAMOS, 1979).

Lobster fishing is conducted at and around the disposal site. There are about 14 boats that fish this area. All the fisherman work full-time at lobstering from their home ports of Point Judith, Newport, and Sakonnet, Rhode Island. The number of pots fished at the site range from 100 to 200. Most of the fishing takes place in the summer months of July and August. The fishermen use the area as they follow the lobster migration into offshore water; however, some fishermen go no further than this area. The pot catches are better on the disposed sediments than the surrounding sandy bottom, but are similar to other soft-bottom areas. Prior to disposal, the site was fished by draggers. But now the disposal pile prevents dragging, and lobstermen are able to fish the area almost exclusively (DAMOS, 1979).

Other commercial fishing methods are used in and around the disposal site. Line trawling (long lines with baited hooks) has been used to catch cod along the 30 meter contour at the site. This fishery is primarily done by lobstermen in the winter time. Gill netting (a net hung in the water that entangles or gills fish) is done in the area; this method is used by fishermen from Sakonnet, Rhode Island. Another commercial fishing effort that takes place along the coastline is the floating trap fishery. The major trap fisheries are located off Newport and Sakonnet within 3 to 4 miles off the disposal site. The primary fish caught is scup. In the mid 1960's scup landings were substantial in this area; however, the landings declined during the disposal of the Providence Harbor sediments. It was the contention of the fishermen that turbidity created during disposal and erosion of the pile had caused the scup to change their migratory route, and this was why the landing declined (DAMOS, 1979).

Endangered Species

There are no known endangered or threatened species found at this disposal site, nor has there been declared any habitat critical to the survival of any such listed species.

Environmental Effects of Disposal

The environmental effects that could be expected during a disposal operation can be subdivided into physical and chemical impacts. The physical impacts are the burial of organisms at the disposal site and the release of a suspended sediment cloud (turbidity) into the surrounding water column. The chemical impacts associated with disposal are the release of any chemicals associated with the sediment into the surrounding waters at the site and the bioaccumulation of chemicals found in the disposal pile. These factors will be addressed in this portion of the EIS; however, an indepth analysis can be found in the Environmental Consequences Section.

Physical Impacts

Many of the benthic organisms present at the dump site will be buried under the disposal pile. The two species of direct economic importance that would be significantly impacted would be lobsters and ocean quahogs.

Brenton Reef Disposal site is about one square mile in area. A "worst case" assumption would be that all lobsters in the dump site would be lost due to burial. Under this assumption a maximum of 405,000 lobsters could be buried and most likely lost to the fishery. After the disposal operations had been completed, lobsters would probably return to the area, and in a few years the population may return to its predisposal levels or even increase since new lobster habitat would have been created and there would be a new food source available to them. This worst case analysis greatly overstates the potential impact. Brenton Reef has had about 10 million cubic yards of material disposed at the site, and only about 1/3 of the site has been covered. Therefore, the disposal of 4.8 million cubic yards of sediment would actually cover a small portion of the disposal site, and a relatively small number of lobsters. Of course, should the site be used in other disposal operations, additional losses of lobsters may occur.

An estimate of annual economic impact to the lobster fishery may be calculated with the following "worst case" assumptions:

- Five to 10 percent of the total population of lobsters (405,000) is of legal size and therefore available for harvest (Saila, 1982, pers. comm.).

- All of the legal sized lobsters will be captured and marketed.

- The price per pound realized by the fishery is $2.50 (NMFS, Port Agent, Pers. Comm., 1982).

- The legal sized lobster captured by the Rhode Island fishery averages one pound in weight.

The loss of the fishery utilizing the 10 percent value is estimated to not exceed $101,250 on an annual basis.

Two of the assumptions used are considered to be quite conservative. It is not likely that 10 percent of the population is of legal size nor are they all harvested within each year.

The burial of ocean quahogs at Brenton Reef would be a permanent loss of this shellfish habitat. A similar "worst case" analysis would reveal that about 6,000 bushels of ocean quahogs would be buried. Even though this may be a permanent loss of this shellfish habitat, it may not be a significant one since past disposal operations have limited the usefulness of this area for ocean quahog fishing.

A cloud of suspended sediments would occur at the disposal site when dumping is underway. The quality of material present in the cloud varies with the type of sediments being disposed of. It has been found that no more than 1 percent of the discharged material enters the water column and most of the suspended material is found within a few meters of the bottom. The cloud completely dissipates after about 15 minutes.

Laboratory testing procedures have been developed by EPA and the Corps (Implementation Manual) for assessing the potential impacts from the release of suspended sediment into the surrounding water at disposal sites. The prevailing test used is the suspended-particulate phase of the bioassay test. This test involves the mixing of sediments and water. Selected sensitive marine or estuarine organisms are placed in this mixture and observed for 96-hours. If any mortality occurs, a statistical analysis is conducted to determine whether the mortality occurred by chance or whether they were caused by the suspended sediments being present. The test results for the Fall River sediments showed there should be no significant mortality to organisms exposed to this phase of the material discharged at the disposal site.

Any impacts from turbidity should be insignificant, and those that might occur should only last as long as disposal is taking place.

During the disposal of Providence Harbor sediment at Brenton Reef, the trap fishermen near the mouth of Narragansett Bay experienced a reduction in their scup landings. It was the fishermen's contention that disposal and the erosion of the dredge sediment from the pile was frightening scup away from their traps. An analysis conducted by the Marine Experiment Station at the University of Rhode Island concluded that the reduction in Rhode Island scup landings was no greater than the reduced landings that were occurring all up and down the Atlantic Coast. This was considered a natural fluctuation and had nothing to do with disposal. Further, scup enter estuaries to feed and spawn, and since these areas have naturally high turbidity levels it is reasonable to assume that if turbidity frightens these fish, they would not frequent this type of habitat.

Chemical Impacts

Sediments found in industrial harbors often contain elevated levels of many contaminants. These can include heavy metals (mercury, cadmium, lead, etc.), petroleum hydrocarbons, and organic chemicals. These chemicals are usually present because of the fine grained nature of sediments. The sediments adsorb these chemicals and carry them to the bottom. In the past it has been generally stated that upon disposal many of these contaminants could be released and might be toxic to benthic organisms or could be accumulated by benthic organisms and passed up the food chain.

A bioassay test was conducted to assess the possible toxic effects of the Fall River sediments and the possible accumulation of certain chemicals. The liquid phase results indicate that toxic chemicals might be released into the surrounding water since one of the three test species (Acartia tonsa) did have significant mortality. However, this phase of discharged material would be diluted rapidly at a disposal site, and an analysis shows that it would be reduced to acceptable levels within 4 hours.

The scientific literature presented in the Environmental Consequences section explains that fine grain sediments bind most chemicals very tightly, and there is usually no significant release of toxic chemicals during disposal.

The bioaccumulation portion of the bioassay test determines whether the test organisms accumulate mercury, cadmium, polychlorinated biphenyls (PCB's), organochlorine pesticides (DDT family), and petroleum hydrocarbons when exposed to the solid phase portion of the material for a 10 day period. The test on the Fall River sediments showed that petroleum hydrocarbons may be accumulated by shellfish, when exposed to material from one of seven sites tested and by sandworms when exposed to two of the seven sites. There was no statistically significant accumulation of any Hg, Cd, PCB's or DDT in any of the three test species exposed to any portion of the Fall River sediments.

The bioaccumulation of a toxic chemical is important when there is the potential for that chemical being magnified up the food chain. When oil pollution first received national attention, a few scientists speculated that petroleum hydrocarbons were biomagnified; however, research to date indicates that biomagnification of petroleum does not occur.

Therefore as discussed in the Environmental Consequences section, disposal of the Fall River sediment at Brenton Reef Disposal site should not result in a significant impact to organisms at or near the site due to either the turbidity cloud created or to any chemicals released into the water or contained in the sediments. There also should not be any significant long term effects from the presence of chemicals in the sediments. Sediments are "sinks" for most contaminants and not a source for these chemicals. This is evidenced by the concentrations found in sediments which normally contain contaminants in the parts per million or in extreme cases, parts per thousand range. In water, the concentrations are usually in the parts per billion or parts per trillion range, and yet water is the source for contaminants found in sediments.

Cultural Resources

Coordination with the State Historic Preservation Officer for the State of Rhode Island (Letter 12 April 1982) confirms that disposal at Brenton Reef would "have a low probability of adversely effecting important cultural properties." He further indicates that archeological surveys of the area is not recommended.

IV. ENVIRONMENTAL CONSEQUENCES

The analysis presented in the Alternatives section showed that upland disposal was not an acceptable option for the proposed Fall River project. The land requirements would be substantial, and the social acceptance of a disposal site adjacent to residential areas would be unlikely. Shallow water disposal within Mount Hope Bay would also not be an acceptable option. Again, the acreage necessary would be substantial, and the construction requirements would make this option a significant undertaking. There are only two open water sites which could be used at this time for disposal of the Fall River sediments: the proposed Brenton Reef Disposal site and the Browns Ledge site. The other suggested disposal sites would be much more expensive economically, require the gathering of extensive environmental data, and involve new areas as not previously used as disposal sites.

Project Impacts

The impacts can be subdivided into two categories -- the physical and the chemical impacts. The physical impacts would include the dredging of a quantity of quahaugs from Mount Hope Bay, the creation of turbidity (suspended sediments) in the bay and at the disposal site, and the burying of lobsters and ocean quahaugs at the disposal site. The chemical impacts would include the potential release of constituents into the water at the dredging and disposal site, the potential toxic effects from the sediments deposited at the disposal site, and the potential biomagnification of certain chemicals up the food chain. Each of these impacts will be discussed in this section.

Physical Impacts

The impacts of dredging are mainly related to the immediate area of dredge operations. Deepening and widening of the channel will result in the loss of bottom area adjacent to the channel as the banks slump into the depression. This will cause the loss of organisms which are removed with dredged material, and will remove about 2 million square feet of existing bottom area. The primary commercial species of concern in Mount Hope Bay is the quahog (*Mercenaria mercenaria*). A 1980 Mass. Division of Marine Fisheries survey yielded a catch of 69 quahogs per 505 square feet as a maximum. Using this density, the maximum loss of clams would be 433 bushels. This loss would not be replaced over time a the substrate would have been lost.

Dredging and disposal has the potential for creating several adverse impacts to those organisms found in an aquatic environment. These two operations can create high levels of suspended sediments in the water which could kill the adults, juveniles or eggs present, or frighten fish from the area. During the 1967-1977 period of disposal at Brenton Reef, the local trap fishermen claimed the latter was occurring, and this was why their catches of scup were substantially lower.

Over the years, laboratory testing procedures have been devised by the EPA and Corps for assessing the potential impact from the release of suspended sediments into the surrounding water. The test used is the suspended particulate phase of the bioassay test. The test involves making a mixture of water and sediments to be dredged. Marine or estuarine organisms are placed in this mixture and observed for 96 hours. If any mortalities occur a statistical analysis is conducted to determine if the mortalities occur by chance or if the presence of the suspended sediments was the cause. For the Fall River sediments, the test results show there should be no significant environmental impacts at the proposed disposal site.

There has been a substantial number of studies on the effect of turbidity on estuarine as well as marine organisms. The results of these studies have demonstrated that turbidity very seldom causes a significant ecological problem. The following paragraphs discuss these studies.

The amount of suspended material created by dredging can vary epending upon a number of factors. The primary ones are size of the particles, solid concentrations, type and size of the dredge and hydrologic characteristics of the area. The importance of these factors can vary greatly from site to site, but it has generally been found that concentrations do not exceed 0.5 mg/l (500 ppm) and that the average is likely to be less than 0.1 mg/l (100 ppm) (Barnard, 1979; Bohlem _et al._, 1979; and Schubel and Wang, 1973.

Turbidity can also be created at the dump site. Gordon (1974) demonstrated that 99 percent of noncohesive dredge materials of high silt content discharged from a scow with tides present move towards the bottom as a high speed, turbulent jet. When 2,000 cubic meters (m^3) of dredged material with about 50 percent water content was discharged into 20 m of water, less than 18 percent of the materials was carried beyond a 30 m radius of the bottom and essentially none beyond 120 m. Measurements near the surface showed clouds of particles 10 m in thickness and 60 meters in diameter drifting with the tide. This cloud did not contain more than 1 percent of the material discharged. The majority of the turbidity was within 5 meters of the bottom. The initial plume at the bottom was 12 meters. The plume spread at about 12 meters/minute, but the plume was completely dissipated after about 15 minutes.

Many studies have been conducted on the effects of suspended material on marine and estuarine organisms as well as on their eggs and larvae (Loosanoff, 1961; Loosanoff, 1965; Davis, 1960; Saila _et al._, 1968; Davis and Hidu, 1969; Mackin, 1956; Stone _et al._, 1974; Peddicord _et al._, 1975; Schubel and Wang, 1971; Auld and Schubel, 1977; Peddicord and McFarland, 1978; Sherk and O'Connor, 1971; and Kiorboe, 1981). As might be expected, the tolerance among the various organisms varied greatly -- some showed extreme resistance to suspended sediments while others would be considered relatively intolerant when compared to the resistant organisms. Only two of the above studies will be discussed -- Davis and Hidu and Saila _et al._ -- since these two studies showed the two extremes of sensitivity.

The egg and larvae are considered to be the most sensitive stages of many animals, and there is a belief that a significant reduction in reproductive success or survival of eggs, larvae or juveniles may be of greater ecological importance than the loss of part of the existing adult population. Since Davis and Hidu studied the affects of suspended materials on eggs and larvae survival, their results are important in evaluating the consequences that might occur from dredging and disposal. Table 13 lists some of their results.

Table 13

Survival Rates - Varying Concentrations Suspended Material

Concentrations	Silt		Silicon Dioxide	
	% Survivors		% Survivors	
PPM	Clam	Oyster	Clam	Oyster
0.0 (Controls)*	100	100	100	100
125	95	95	106	94
188	90	78	—	—
250	96	73	105	109
375	93	66	—	—
1,000	99	31	105	93
2,000	39	0	85	114
4,000	0	0	69	123

*Controls considered 100%

As the table shows, silt concentrations of 500 ppm lead to a substantial reduction in the number of oyster eggs that developed into the straight-hinge stage, only 31 percent reached this stage. With silicon dioxide (sand), the oysters faired better than clams. As for adult organisms, Saila *et al.* (1968) studied mortality of lobsters using kaolin (clay) and found no mortality with concentrations as high as 50,000 ppm.

The studies cited in the first portion of this section showed that suspended material produced by dredging generally does not exceed 500 ppm, and normally less than 100 ppm would be generated. The table above shows oyster and clams were, for the most part, unaffected by concentrations of 125 ppm. Lobsters were even more resistant.

Therefore, even if dredging were to take place at a sensitive life stage, there would be little reason to expect any major impacts. As Sherk (1972) remarked in his report on the effects of turbidity "... the survival and growth capacity of these eggs and larvae (oyster and clams) observed by Davis and Hidu (1969) under exposure to particles ranging in size from colloids to fine sand at concentrations up to 4 g/l (4,000 ppm) demonstrate a remarkable ability to tolerate the sometimes high and extremely turbid nature of the estuary environment."

As for the possibility of frightening scup from the area, Sissenwine and Saila (1974) investigated this problem. Their conclusion was: "The coast-wide decline of scup fisheries could not have been affected by the Rhode Island Sound disposal site, and there is no evidence that it resulted from any more widespread man-made environmental perturbation." Further, in Gordon's work on turbidity at a disposal site, it was pointed out that after about 15 minutes the bottom turbidity had completely dissipated. A turbidity cloud with such a short life should not affect fish that spend much of their time feeding on the bottom in shallow water where naturally high turbidity levels can be created by storms and tidal currents.

The Brenton Reef and Brown Ledge disposal sites are each approximately one square mile in area. There are slightly less than 2,590,000 square meters in a square mile. It has been found that productive lobster habitat in Rhode Island waters would contain one lobster per 6.4 m^2 (Mike Fogert, NMFS, Personal Comm.). Thus, the total potential number of lobster in a one square mile area would be slightly less than 405,000 animals. Assuming a "worst case", that all the lobsters at the disposal site would be buried and die, the total loss of lobsters at either site would be 405,000 individuals. This should be a one-time loss, and either site could return to a productive habitat within a few years, as occurred at Brenton Reef in the past.

A similar analysis could also be used for the loss of ocean quahogs at the two sites. However, Brenton Reef has been partially filled from past disposal operations. About two-thirds of the site still remains uncovered. It has been found that there can be from 30 to 40 quahogs per square meter (Medicaf and Caddyl, 1971). For Brenton Reef, the total loss of quahogs from burial would be 69,040,000 or about 92,000 bushels; while for Browns Ledge, the figures would be 103,600,000 or about 137,000 bushels. The loss of the ocean quahogs would likely be a permanent condition for the foreseeable future.

Both of these "worst case" analysis are felt to grossly over estimate the potential impacts. The disposal of 4.7 million cubic yards of sediments would likely cover less than one-half of the site, since the prior disposal of 10 million cubic yards covered about one-third of the Brenton Reef site. Thus, the impacts due to burial should be less than one-third of the numbers presented.

Chemical Impacts

Sediments found in the rivers and harbors of industrial areas often contain elevated levels of contaminants. This is because as Forstner *et al.* (1978) points out, "Sediments express the state of the overlying water body." In other words, if the water over sediments contain elevated levels of PCB's or some other constituent, the sediments would also contain elevated levels of this constituent. However, the concentrations found in water are usually in the parts per billion (ppb) range; whereas, in sediments the concentrations can be in the parts per million (ppm) or, in unusual cases, in parts per thousand. This means that sediments absorb many constituents and hold them, but it does not mean contaminants are not released from sediments. The system is a dynamic one, there can be movement both ways but the predominate movement is into the sediment (Chen et al., 1976 and Turekian, 1973).

To assess the potential for adverse impacts, a number of tests have been developed over the years. These include the Bulk Sediment Test, Elutriate Test, EP Toxicity Test and the Bioassay Test. The testing and sampling program for this proposal was developed in cooperation with state agencies from Rhode Island and Massachusetts as well as the U.S. Environmental Protection Agency. This section will discuss the four tests used for evaluating the properties of the sediments proposed for dredging and will present information found in the literature on the potential adverse impacts that might be expected from dredging and disposal of the Fall River sediments.

The Bulk Sediment Test involves the digesting of sediments with an acid, and the resulting solution then being tested for such constituents as heavy metals (mercury, cadmium, arsenic, etc.), organic compounds such as PCB, DDT and other such chemicals. The test has only limited value for it does not indicate the biological availability of any of the chemicals being measured. Nevertheless, it gives an indication of what chemicals are present in the sediment and therefore what chemicals should be looked for in other more, sensitive tests.

Table 14 displays the results of the bulk sediment test and shows Connecticut-New York Interim Plan classification system. Although this system was established for Long Island and is, therefore, not totally applicable to Rhode Island Sound, it does allow for a gross comparison of contaminant levels. Under this system, sediments are classified as I, II or III. Class I sediments are essentially non-polluted and are suitable for cappying materials at open water dump sites, for habitat creation projects, or for other productive uses including beach nourishment and land fill cover. Class II sediments are relatively clean and are categorized either "nondegrading" or "potentially degrading." Potentially degrading Class II sediments would be considered as Class III materials. Class III sediments contain high levels of volatile solids, oil and grease and metals. There are two ways in which the material is evaluated: physically and chemically.

Table 14

Fall River Sediments Results

PARAMETER	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	I	II	III
DEPTH (Inches)	0-3	0-3	0-3	0-3	0-3	0-3	0-3	0-3	Surface	0-3	0-3	0-3	0-3	0-3	0-3			
% OIL & GREASE	0.169	0.191	0.21	0.112	0.132	0.09	0.172	.0375	0.007	0.213	0.377	0.167	0.144	0.115	0.176	<1.2	0.2-.75	>.75
% VOL. SOLIDS	4.4	6.5	5.0	5.9	3.5	2.6	3.1	2.9	0.4	3.8	4.8	3.2	5.7	4.5	5.4	<5	5-10	>10
% WATER	52	60	57	64	54	46	48	45	16	60	58	46	68	58	65	<40	40-60	>60
% SILT-CLAY	89	92	96	98	96	95	97	98	6	97	78	90	63	91	82	<60	60-90	>80
MERCURY - ppm	3.2	3.1	2.0	2.3	1.2	0.8	0.4	1.2	0.2	7.3	1.3	0.7	1.6	1.4	1.4	<0.5	0.5-1.5	>1.5
LEAD - ppm	47	56	42	38	26	16	56	42	23	39	32	24	50	36	55	<100	100-200	>200
ZINC - ppm	148	126	104	119	68	91	112	88	110	100	84	65	141	131	706	<200	200-400	>50
ARSENIC - ppm	10	12	11	9.3	7.3	5.9	9.2	6.3	2.6	8.2	5.7	5.5	9.4	5.7	7.2	<10	10-20	>20
CADMIUM - ppm	2	2	2	1	6	6	<1	6	<1	8	2	8	<1	12	<1	<3	3-7	>7
CHROMIUM - ppm	163	315	137	165	57	49	57	44	13	93	34	23	112	42	108	<100	100-300	>300
COPPER - ppm	38	52	32	38	20	19	20	30	6	42	30	17	43	42	34	<200	200-400	>400
NICKEL - ppm	46	44	33	43	61	55	49	76	32	60	59	28	27	24	38	<50	50-100	>100
VANADIUM - ppm	<40	100	<40	<40	40	40	<40	40	<40	50	<40	40	50	40	<40	<75	75-125	>125
PCB's - ppm	.037		.021	.015			.001				.011		.032		.022		<1.0	
DDT's - ppm	.05		.006	.006			<.0001				.0002		.003		.002		<0.05	
DIELDRIN - ppm	.0001		.0009	.0001			<.0001				.0008		.0013		.0018		<0.1	

Using this system the Fall River sediment would be categorized as primarily Class I and "nondegrading" Class II; thus the sediments would be considered relatively clean as measured by the bulk sediment test.

The Elutriate Test is used to indicate the amount of contaminants that might be released into the surrounding water during dredging and disposal. The test consists of combining 1 part sediments with 4 parts water from the dredge site. This is mixed for 30 minutes, and then allowed to settle for 1 hour. After settling, the mixture is centrifuged and filtered. The liquid is then tested for many of the same chemicals measured in the bulk sediment test. Table 15 contains the test results and EPA's marine water quality criteria for comparison. The results show that most contaminants were not released from the sediments and, in some instances, chemicals were actually absorbed from the water.

The EP Toxicity Test approximates the conditions that might occur from acid rain leaching through a solid waste placed on an upland disposal site. This test involves agitating sediment for 24 hours in an acid solution with a PH of 4.9 to 5.2. After the 24 hours, the solution is filtered and tested for the various chemicals. If the concentrations exceed 100 times EPA's drinking water standards, the waste is considered hazardous. Table 16 displays the results from this test. They show there was little or no leaching of chemicals from the sediments.

The test used for evaluating potential impacts from open water and ocean disposal is the Bioassay Test. This test is intended to evaluate whether disposal would cause any "unacceptable environmental impacts" to organisms either from sediment toxicity or from the accumulation of chemicals. In this test marine organisms are placed in tanks or aquaria and observed for specific periods of time. The test results are statistically analyzed to determine if the results were a random occurrence or were caused by the test sediments.

In the toxicity test, three phases can be analyzed -- the liquid, suspended particulate and solid phases. These phases relate to what may occur when dredged sediments are disposed in water; that is, sediments can contain a substantial quantity of water which can be released and mixed with the disposal site water. This correlates to the liquid phase of the bioassay test. Sediment can also contain substantial amounts of fine particles, which can also be released into the disposal site water. The suspended particulate phase portion of the test simulates this condition. Of course, a substantial portion of the dredged material would reach the bottom of the disposal site. This is correlated to the solid-phase portion of the test. Finally, those organisms that survive the solid-phase are analyzed to determine if they have accumulated mercury, cadmium, petroleum hydrocarbons, polychlorinated biphenyls (PCB's) and compounds in the DDT family.

Table 15

Elutriate Results

Parameters	Levels	EPA's Water Quality Criteria	Mean of 3 Replicates for Site A	Mean of 3 Replicates for Site C	Mean of 3 Replicates for Site D	Mean of 3 Replicates for Site G	Mean of 3 Replicates for Site K	Mean of 3 Replicates for Site M	Mean of 3 Replicates for Site O
Mercury	ppb	<3.7	<0.5	<0.5	0.5	0.96	0.6	<0.5	0.7
Lead	ppb	<25	<5	<5	<5	<5	<5	<5	15
Zinc	ppb	<170	<40	<40	<40	<40	<40	<40	41
Arsenic	ppb	<508	10.6	4.9	16	5.4	17.7	2.6	1.1
Cadmium	ppb	<59	1.5	2	1	<1	<1	<1	<1
Chromium	ppb	<1,260	<4	<4	<4	<4	<4	<4	4.7
Copper	ppb	<23	<2	<2	<2	<2	<2	<2	2.7
Nickel	ppb	<140	<5	<5	5.6	<5	<5	<5	15
Vanadium	ppb	--	<40	<40	<40	<40	<40	<40	<40
Silver	ppb	2.3	<80	<80	<80	<80	<80	<80	<80
Barium	ppm	--	0.02	0.03	0.02	0.02	0.02	0.03	0.02
Beryllium	ppm	--	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Selenium	ppm	<.41	0.04	0.03	0.03	0.02	0.02	0.01	0.02
PCB	pp Tril.	<10,000	3	1	5	3	3	2	3.7
DDT	pp Tril.	<130	5	<1	<1	<1	<1	<1	<1
Dieldrin	pp Tril.	--	<10	<10	<10	<10	<10	13.3	10
Oil & Grease	ppm	--	0.05	0.04	0.10	0.09	0.02	<0.02	0.47

Table 16

EP Toxicity Test Results

Parameters	Maximum Concentrations*	A	C	D	G	K	M	O
Mercury ppm	0.2	<0.001	0.003	<0.001	<0.001	<0.001	<0.001	
Lead ppm	5.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
Zinc ppm								<0.001
Arsenic ppm	5.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Barium ppm	100	2.0	2.0	1.5	1.0	<1.0	<1.0	<1.0
Cadmium ppm	1.0	.03	<0.02	<0.01	0.02	0.01	<0.01	<0.01
Chromium ppm	5.0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Copper ppm		<0.2						
Selenium ppm	1.0		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Silver ppm	5.0	<0.01	<0.02	<0.01		<0.01	<0.01	<0.02
Beryllium ppm					<0.01			
Organohalogen Pesticide		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

*Concentration standards found in Federal Register/Vol. 45, No. 98 Monday, May 19, 1980 p. 33122.

In the toxicity portion of the Fall River bioassay -- the liquid, suspended particulate and solid phase -- there was only one instance of significant mortalities, and this was with the zooplankton, Acartia tonsa, and this occurred with the liquid phase. However, under the evaluative procedures used for this segment of the test, (EPA/Corps Implementation Manual) dilution analysis is done to determine if the toxicant can be reduced to acceptable levels. This analysis shows that this would occur within 4 hours, which is considered acceptable.

In the bioaccumulation portion of the test, there were statistically significant accumulations of petroleum hydrocarbons in both the hard clam and the sandworm from sediments from three of seven areas tested, but there was no significant accumulation of any other constituents by any of the three types of organisms used in this test. (A summary of the test results can be found on Table 17; the full text of the bioassay will be supplied upon request.)

The results from all four tests show the Fall River Channel sediments to be relatively clean. This would indicate that there should be few, if any, problems with dredging and disposal as far as the chemical constituents are concerned.

These tests were conducted specifically for the proposed Fall River projects; but there is also a substantial body of scientific literature that supports the test results, showing there should not be a significant impact from the proposed project.

Table 17

Summary of Bioassay Results

Toxicity Test	Species Tested	Statistical Analysis
Liquid Phase	Acartia tonsa (copepod)	*Significant mortalities
	Neomysis americana (shrimp)	No significant mortalities
	Menidia menidia (fish)	No significant mortalities
Suspended Particulate Phase	Acartia tonsa (copepod)	No significant mortalities
	Neomysis americana (shrimp)	No significant mortalities
	Menidia menidia (fish)	No significant mortalities
Solid Phase	Palaemonetes pugio (shrimp)	No significant accumulation for the 3 species combined
	Mercenaria mercenaria (clam)	
	Nereis virens (marine worm)	
Bioaccumulation Test		
Cadmium	Palaemonetes pugio (shrimp)	No significant accumulation
	Mercenaria mercenaria (clam)	No significant accumulation
	Nereis virens (marine worm)	No significant accumulation
Mercury	Palaemonetes pugio (shrimp)	No significant accumulation
	Mercenaria mercenaria (clam)	No significant accumulation
	Nereis virens (marine worm)	No significant accumulation
PCB's	Palaemonetes pugio (shrimp)	No significant accumulation
	Mercenaria mercenaria (clam)	No significant accumulation
	Nereis virens (marine worm)	No significant accumulation
Petroleum Hydrocarbons	Palaemonetes pugio (shrimp)	No significant accumulation
	Mercenaria mercenaria (clam)	**Significant accumulation
	Nereis virens (marine worm)	**Significant accumulation

*Dilution analysis show mortalities could be reduced to acceptable levels.
**See text for discussion on ecological significant of accumulation of petroleum hydrocarbons.

The following paragraphs describe these studies and their conclusions. It should be noted a complete discussion of the literature is presented for heavy metals, hydrocarbon uptake and PCB's even though the presence of these constituents in the Fall River project sediments is limited. It might be helpful to identify the ways aquatic organisms can accumulate or incorporate chemicals into their systems. Accumulation can occur through water, known as bioconcentration; through food, known as biomagnification; or through a combination of both, known as bioaccumulation. The source of accumulation is important since it provides a better understanding of how possible adverse impacts might occur. For example, as discussed in the following cases it has been found that most aquatic organisms accumulate contaminants from the surrounding water far more readily than from sediments. Therefore, if dredging or disposal releases substantial amounts of contaminants into the surrounding water, it is possible that a significant impact might occur to any organisms present. On the other hand, it would also follow that if few contaminants are released, the impact should be small or insignificant.

In 1972 Fujiki studied the uptake of mercury from sediments found in Minamata Bay. He discovered that the concentrations present in organisms came from uptake of mercury and methyl mercury from the two wastewater discharges manufacturing plants, and not from the concentrations accumulated in the sediments. For example, one species of shellfish contained 178 ppm (dry weight) in 1961, but only 7 ppm in 1970. Along these same lines, the average levels of mercury in 8 species of fish fell from 23 ppm (wet weight) in 1961 to 0.2 ppm in 1970. Nevertheless, the sediments in 1970 still contained as high as 100 ppm of mercury at some locations. This same author, along with others (Fujiki et al., 1977), reared red sea bream in tanks containing sediments from Minamata Bay. Little accumulation of methyl mercury occurred; the control and test fish had nearly the same levels of this metal. Other authorities on heavy metals have found that there is little or no accumulation of mercury from contaminated sediments (Armstrong and Scott, 1977; Luoma,1977; Eganhouse and Young, 1978). What has been found is that organisms primarily accumulate mercury from the water.

Still other researchers have conducted similar studies with other metals and with other species, and have drawn similar conclusions. For example, in a field study, deGoeij at el. (1974) tested the concentrations of metals in Dover sole livers. (Livers were used because they concentrate heavy metals.) From certain conditions found in and on the fish, the researchers concluded that the sole had been on polluted sediments for an extended period. They found that the concentrations of several toxic metals in these fish livers were not significantly different from those fish living on natural sediments. Table 18 displays some of their results.

Table 18

Concentrations of Toxic Metals in Fish Livers

Metals	Highly Contaminated Sediments	Natural Sediments
As	1.3 ± 0.2	3.1 ± 0.7
Cd	0.2 ± 0.06	0.6 ± 0.3
Ca	2.2 ± 0.4	2.2 ± 0.5
Hg	0.11 ± 0.02	0.11 ± 0.04
Zn	26 ± 3	27 ± 4

The concentrations of 12 trace elements (chromium included) in the livers of Dover sole do not increase as a result of exposure to and feeding in the contaminated sediments. (For other studies on heavy metals, see Young et al., 1981; McDermott et al., 1976; Topping, 1973; Cross et al., 1980; and Cross and Sunda, 1977.)

Finally, Luoma and Jenne (1975) pointed out, "Partitioning of metal within mixed sediments is a function of the stability constants and the abundance of the various sinks. This means that, among the most abundant sinks within a given sediment, metals will be selectively partitioned into those sinks with the greatest affinity for metal sorption; i.e., there will be a tendency for metals in mixed sediments to partition into those sinks with the lowest bioavailability." The importance of this statement should not be overlooked, for what the authors are saying is when high concentrations of metals are present, they are strongly bound to the sediments and are least available to organisms.

Sediments themselves, therefore, based on these study results, would not be a major source for heavy metal accumulation. The next question discussed is whether dredging and disposal could release significant quantities of metals into the surrounding waters at either site.

The Corps of Engineers has conducted or had conducted a number of laboratory and field studies of the release of heavy metals during dredging and disposal (Chen _et al._, 1977; Teeney and Hall, 1977; Wright _et al._, 1978; Armstrong and Scott, 1979; Baumgartner _et al._, 1978; Suga _et al._, 1978; and Windom, 1975). In each of these studies, heavy metals were released in small amounts, but the concentrations soon returned to background levels. Sustav and Wakeman, 1977, investigated the change in water quality and the uptake of contaminants during dredging and disposal; they found " . . . water quality impacts were not found to be synonymous with biological impacts." Based on this work it appears that there should not be any significant impacts from the accumulation of heavy metals in the sediments or from the surrounding waters at the dredge or disposal sites.

There has been some concern that small amounts of metals incorporated by an organism might lead to food chain magnifications. The discovery of generally higher concentrations of mercury in the muscles of large predatory fish, such as tuna and swordfish, than in the muscles of fish and other organisms at lower trophic levels led to the theory that bioamplification occurs up the food chain. However, it appears that the higher concentrations are not so much a function of trophic level, but of time. Tuna and swordfish both live for relatively long periods and are very large and that is why they have elevated mercury levels (Cross et al., 1973).

Except where age and size seem to be significant factors in accumulating mercury, little evidence of bioamplification exists. This has been confirmed by field analysis of organisms at different trophic levels for mercury and other metals (Knauer et al., 1972; Cocoros et al., 1973; Leatherland et al., 1973; Windom et al., 1972; Williams et al., 1973; Mearns and Young, 1980; and Young et al., 1980). Further, experimental studies tend to confirm that there is no clear relationship between heavy metal concentrations and food chain position (Hannerz, 1968; Laumond et al., 1973; Fujiki et al., 1975; Aubert et al., 1973). Scientific study indicates that food chain transfers may not be a significant problem. To summarize, study results have shown that no major accumulation of heavy metals should occur from the sediments, water or food due to dredging and disposal.

In 1977 Boehn and Quinn studied hydrocarbon uptake by clams at and around the Brenton Reef site. They found that "quantitative and qualitative distribution of hydrocarbons in these clams suggest a small (if any) input of dredge spoil hydrocarbons." They go on to state " . . . given the strong affinity of hydrocarbons for solid surfaces, ingestion of whole sediment particles may not result in any transfer of hydrocarbons from the sediment particles to the clam tissues." Other researchers using other organisms have made similar observations (Rossi, 1977; Anderson et al., 1976; Anderson et al., 1977; Roesijadi et al., 1978; and Roesijadi and Anderson, 1979). What has been determined (Cowell, 1976) is " . . . one must conclude that while oil pollution does have an effect upon the marine ecosystem and that more measures must be taken to reduce the incidents of oil spillage into the sea, nevertheless, its chief problem is the aesthetic revulsion to the more persistent but virtually nontoxic fractions that are all too familiar a sight on the world's beaches." Sindermann (1979) made a similar observation when he stated, " . . . except in the immediate vicinity of urban areas and major industrial sites, even this chronic contamination probably produces little if any measurable general effects on fish and shellfish species. Local effects have certainly been demonstrated - and localized changes in species distribution and abundance reported - but no major reductions in species abundance have been directly ascribed to oil pollution."

It was suggested by Blumer (1970) that petroleum assimilated into organisms could become concentrated up the food chain. However, other studies (Burns and Teal, 1973; National Academy of Science, 1975; and Corner, 1975) have shown that food chain magnification does not occur.

Thus, as with heavy metals, it appears that there should be no significant problems with the dredging and disposal of sediments containing petroleum hydrocarbons.

In 1968 an outbreak of a skin disease occurred in Japan; over 1,000 people were afflicted with the disorder. The cause of the disease was identified as being rice oil used for cooking. The oil had been contaminated with a commercial brand of polychlorinated biphenyls (PCB's). This incident brought the presence of this chemical into public awareness. It is now well known that PCB's are widely distributed throughout the environment, and the possible problems with this chemical have received intensive research as well as much speculation. The availability of the PCB's from food, water and sediments are addressed below.

Many researchers have investigated the suspected magnification of PCB's up the food chain. In the marine environment, biomagnification has been accepted for the higher trophic levels such as birds and mammals that feed on fish; however, it has not been clearly documented (Rosenberg, 1975). And while passage through the food chain has been accepted in the past, other studies now question this view.

For example, Harvey et al. (1974) and Harvey and Sternhauer, 1976 could find no evidence to support the popular food chain magnification theory with any of the fishes they studied. In 1972 Zitko and Hutzinger fed fish a diet contaminated with PCB's. They also were unable to find any magnification of this chemical.

Along similar lines, Elder and Fowler (1977) were interested in how PCB's were reaching the sediments so quickly, for the known vertical mixing rate was too slow to account for the increase in this chemical in the sediments. They studied the euphausiids feces and the microplankton upon which they feed. These researchers found that typical values of PCB's in euphunsiids ranged from 0.04 to 0.6 ppm's; in the microplankton the values ranged from 1.8 to 4.5 ppm's; while the values in the feces ranged from 5.0 to 38.0 ppm. If food chain magnification occurred, you would expect to find the euphansiids with higher concentrations of PCB's than the food they were feeding on, but the animals had substantially lower concentrations. As the fecal analysis showed, the chemical was slipping right through their system.

In a laboratory study, Macek et al. (1977) studied the relative importance of the two means of uptake, food and water. They concluded that the biomagnification of PCB's, within aquatic food chains, is quantitatively insignificant when compared with bioconcentration. (A similar assertion that water is the primary source for the uptake of PCB was presented by Kenaga, 1972; Scara and Theilacker, 1977; Clayton et al., 1977; and Pavlou and Dexter, 1979). Macek et al. also pointed out that DDT may be the only compound studied where food chain accumulation is a significant contributor to body burden (25 to 60%).

The Corps of Engineers in its Dredge Material Research Program (Chen et al., 1976) had laboratory studies conducted on the release of contaminants from sediments under simulated dredging and disposal operations. The results showed no release of PCB's for the 3-month study. The Japanese conducted a similar study (Murakami and Takeishi, 1976) and found the release of PCB's to be very slight, and considered the released PCB's likely bound to suspended solids. Consequently, the liberation of PCB's during dredging and disposal should be slight, but even then the chemical may be bound to suspended sediments. The DMRP series (Peddicord and McFarland, 1978) studied the uptake of PCB's from suspended materials; the results showed no uptake of this chemical.

From the material presented here, it would appear that dredging and disposal of the material would not lead to any significant uptakes of PCB's.

In summary the test data as well as the analysis presented in this section has shown that there should be no significant impacts from dredging and disposing of Fall River Channel sediment in ocean waters, and disposal in Rhode Island Sound, specifically, should pose no problems, for as Seavey and Pratt (1979) pointed out:

> Open water disposal in nearshore and offshore locations has been extensive. Prior to 1971, when most of the large-scale dredging projects occurred, great amounts of material were deposited in several dumping grounds off Block Island, in a deep portion of the East Passage south of Prudence Island and at Brenton Reef (Table 1). South Prudence was last used in 1966, and since 1971 the use of the offshore sites has been largely curtailed due to opposition from commercial fishing interests and general environmental concerns. During this period, many investigations of these sites (particularly Brenton Reef) have been undertaken by the Army Corps of Engineers, the Environmental Protection Agency and the University of Rhode Island. In general, these investigations show that species composition and sediment type at the dump sites have changed since dredged material has been deposited there. It has been difficult, however, to find evidence that use of these offshore sites for dredged disposal has had any measurable impact on adjacent areas of the Bay State or the Sounds, on their water quality or their fisheries.

Any Adverse Environmental Effects Which Cannot Be Avoided

The proposed Fall River Project would cause short term of turbidity in the water column at both the dredge and disposal site. There is also the possibility of the short-term release of some toxic chemicals at both sites, but any releases should be minimal. There would be burial of organisms at the disposal site; lobsters and ocean quahaugs are the two most important species that would be impacted. There may be some accumulation of petroleum hydrocarbons by those organisms inhabiting the disposal pile, but this should not cause a significant ecological effect.

Relationship Between Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity

Proposed Project

The dredging of the Fall River would have little impact on the biological community found in Mount Hope Bay. The channel is essentially devoid of all organisms except for some transient ones. Therefore, there would be no change on the long term productivity of the area from undertaking this project.

At the dump site, there would be a substantial change. In the short-term, under the area covered by the dumped material, most organisms would be lost. There may be some organisms that would survive on the periphery of the pile, but this would not be a significant number. In the long term, the area could become a viable habitat for some species depending on further use of the site -- the lobster being the most important -- but the long-term productivity of the area should remain substantially lower than the surrounding areas.

Cumulative Impact

In this section, cumulative impacts are looked at from the standpoint of what opening Brenton Reef to this project would amount to in terms of overall volumes, traffic, turbidity, fisheries disruption, looking at impacts on one hand and benefits to the region on the other.

There is now no management strategy for a dumping ground in this region. Of the many options available, each has its drawbacks. Land disposal is used where practicable, but sites adjacent to dredging areas are few. In-water disposal needs to stay away from shellfish areas, which generally abound in shallow areas. Multiple disposal sites within the bays would be difficult to manage. Far out dumping grounds not only penalize fisheries further, but are not economically available to small users.

The State of Rhode Island has conducted its own investigation of needs for dredging over the next 5-year period. The total volume needs are low, considering the area served and the economic return. The 5-year needs are estimated at about 800,000 cubic yards requiring ocean disposal, of which about half are materials from new or improvement projects. Based on experience, about half of this volume would be acceptable for disposal without special consideration. But since the figures are based on an optimistic economic climate, it would be more realistic to project a lesser total number. When considered in the light of dump site impacts, these numbers suggest both relatively light traffic and dumping, and minimal disruption of any on going activity within a square mile dumpsite itself. Based on historic projections of the Massachusetts side of Mount Hope Bay, the requirements for dredging, aside from what will be done in conjunction with the improvement, are light to non-existent within the next 5-year period.

Other known requirements in the region such as New Bedford Harbor would have to take into consideration whether the materials are acceptable for sea disposal under any conditions. There seems to be no uncertainty at this point whether materials from that location would be allowed to be dumped under the provisions of the Ocean Dumping Act or could be certified under the Clean Water Act.

Thus an assessment of cumulative impact can be projected in terms of disposal of less than one million additional cubic yards over a 5-year period from the Narragansett-Mt. Hope Bay region under the most favorable economic conditions. This volume and number of operations are susceptible to management in terms of time of operation, location of dumping, and more importantly, special handling if the situation demands.

This could mean that disruption of fisheries and fishing operations could be minimized by critical scheduling, and that the most important needs of the region could be met without the continuing uncertainties of where or if the next dredging event will have an impact. It offers the opportunity to regulating agencies to set time limits as well as specify locations within the site in order to lessen interference with ongoing activities.

Irreversible or Irretrievable Commitment of Resources

Two classes of resources would be committed if the project were implemented. The first would be those associated with man's undertaking; they would include fuel, money, and manpower. The fuel used to implement the project should involve relatively small quantitites. A working dredge and tugs used to haul the dredged sediments to the site would be the major consumers of fuel, but this consumption of fuel would be made up by the larger and more efficient vessels transporting commerce. The $23 million commitment to this project could be committed to some other proposal; however, the benefits that would be derived during the 50-year life of the project would more than compensate for the initial monies spent. The effect of the manpower utilized would be the same as those of money.

The second class of resources that would be comitted are those of the biotic community. Since the Fall River navigation channel is essentially devoid of life, there would be no new commitment of biotic resources in this area. However, at the disposal site there would be a significant commitment of resources. Lobsters and ocean quahaugs would be buried. The lobster population would likely recover but this may require a number of years. The ocean quahaugs, on the other hand, would not return to their pre-disposal levels, since the disposal sediments would not be suitable habitat for this species. Implementation of the project would be a total commitment of this resource.

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Management Techniques as a Mitigation Procedure

The greatest change that has taken place in ocean disposal technology since Brenton Reef was last used is the development of more precise tools for point dumping marking and bathymetric measurement, as well as the relationships between sediment types, current energies, and overall knowledge, that has been obtained of the behavorial characteristics of disposal sites. The state of chemical stability of various compounds has been exhaustively researched, leading to better predictive methods of bio-availability of chemicals from water column versus sediments.

It is now possible, and is a component built into every dredging job, that the materials to be dredged will be handled in such a manner as to reduce the ecological disruption at the dredge site and disposal site. Beyond that, as a regional management strategy, consideration is given to dredging requirements over time so that the resulting disposal will disrupt the minimum area and produce a substrate that optimizes chances for biological productivity.

When applied to the proposed project, this means that the materials to be dredged would be segregated according to their polluting potential, even though all may be rated acceptable for dumping. The purpose of this is to place on the surface those materials which would be most like the natural surrounding bottom outside the Brenton Reef square mile. The dredging sequence would take into account both the Federal channel and private terminal work, and program that work so that the least offensive materials are dumped last.

The disposal site management operations will provide for the creation of a gentle sloping mound by sequential dumping, using taut-wire buoys for control along with periodic bathymetric surveys.

The materials to be dredged from Mount Hope Bay channels are distributed in terms of volume as follows:

1,950,000 cubic yards	Channel to Fall River
1,700,000 cubic yards	Channels to Tiverton

Private terminal deepening will add the following approximate amounts:

750,000 cubic yards	Brayton Point (NEPCO)
23,500 cubic yards	Borden & Remington
73,500 cubic yards	Tiverton Terminals

Development of the Site Management Plans

The sediments of Mt. Hope Bay have been sampled extensively for various testing purposes. The most recent analyses performed were on 1980-81 samples for purposes of evaluating material against criteria for ocean dispsoal, as well as to satisfy States' agencies' concerns. Ocean Dumping regulations require that potential impacts upon water quality and biota be evaluated by means of various tests, including bioassay and bio-accumulation, utilizing appropriate marine organisms. Application of these tests and evaluation of results, together with existing background information indicate that the materials proposed to be dredged are acceptable for disposal in ocean waters.

While biological analyses indicate acceptability of these materials for aquatic disposal, the presence of elevated levels of grease and oil in discrete reaches of the project allow for consideration of covering such materials with sediment to provide a cleaner substrate.

Based upon sediment data, both physical and chemical, the prospect of enhancing the substrate at the disposal site by proper sequential dumping of materials from various reaches showed promise. Both the earlier Brenton Reef as well as later work in Long Island Sound has demonstrated the efficiency of the "capping" technique, and return of substrate to near pre-dump condition. For purposes of this project, the schedule of disposal would be specified to ensure that the final layer of material at the disposal mound would be composed predominantly of the coarser grained, less contaminated sediments from Reach 4 as shown on Figure 8.

Should permit applications be concurrent with contracting for this project for dredging of private facilities elsewhere, such as Providence Harbor, that work would also be considered within the context of capping materials of less desireable properties with more suitable sediments.

With proper design of a dumping program and appropriate control of operations including inspection of all discharge, it will be possible to utilize less than one-half of the disposal area, and to confine the immediate or short term impacts to that segment. A route to and from the disposal area for tows will be designated after appropriate analysis of fisheries gear requirements.

Disposal Mound Configuration

The following general criteria governing design of disposal mounds are applicable to the Brenton Reef site:

(a) Surface elevation below the effective influence of deep water waves, approx. 80-90 feet MLW.

(b) Side slopes in the range of 1:20 to 1:60 to minimize surface effects of tidal currents and waves.

(c) Strategic scheduling and placement of materials to be dredged in order to produce an optimum surface condition.

(d) Effective control by buoy and bathymetric monitoring, and constant inspection of dumping by government personnel.

The present Brenton Reef Mound has a volume of about 8.5 million cubic yards and rises to a height of about 20 feet above the base elevations of minus 106 feet. Ten year observations of this mound, along with monitoring of similar features in the region indicate that the design described will satisfy the needs of the project and environmental considerations.

The dredged material will be dumped in a sequence which will produce generally the orientation and shape described in Figure 9. The elongated mound with central axis paralleling the E-W boundaries of the site will extend over the mile width of the site and rise to an elevation of approximately -93 feet belwo mean low water. The base of the truncated pyramid mound will cover a width of about 1,600 feet. Gently sloping sides of about 1 vertical to 60 horizontal would result after natural smoothing and consolidation took place.

The volume of this mound of the above-described dimensions is approximately 4.5 million cubic yards. This volume would increase by about 25% if the dimensions were changed to allow a -90 ft. top elevation. This top elevation is below the existing mound, and sides more like those of the most gently sloping face.

The slope described gives rise to the possibility of utilizing the cleft formed between the two mounds as a natural containment site for materials such as those from Providence Harbor which may be rated as less suitable for mounding, and likely more contaminated. This area could be capped with the more granular Mount Hope Bay materials found in the lower reaches.

The sequence of operations would be to progressively construct the mound by mooring the dumping point as the desired limits are attained, and as the dredging progressively seaward. Experience at New London has demonstrated the practicability of this approach, and the New Haven disposal site has been the basis for many refinements in the positioning and selective placement techniques.

Ultimately, the final sequence of dumping operations would place the most granular materials over the surface, a duplication of essentially what resulted in the construction of the existing mound.

Future Use Considerations

The mound design described in the preceding paragraphs would accommodate all of the materials involved in the Mount Hope Bay project, and other private work which has been identified as potential candidates for disposal. Future use of the site, without altering these design considerations would be limited to lesser amounts, up to about 1 million cubic yards , if the site dimensions were not to be exceeded. Unless, there are large improvement works projected, this would accommodate the known maintenance needs of the Narragansett-Mount Hope Bay area for the next five years. In this period of time, initiatives could be taken to establish a contingency site for future operations, such as the extension of the Taunton River channel.

V. COORDINATION

Formal and informal coordination has been maintained with various state and Federal agencies having legal responsiblity or special expertise on the proposed project. The sampling and testing program developed for the determination of the quality of the Fall River Channel sediment was extensively coordinated with Federal and state agences. Coordination has also been maintained with the appropriate State archaeological and historical agencies on the potential impacts the proposal might have on these two concerns. Three public workshops were held, and State and Federal representatives participated in these workshops.

The following chronology of coordination and scoping establishes the extent of these activities carried out for this current phase of activity.

Chronology of Coordination

9 May 1980

On this date, a meeting was held in the Massachusetts State Office building. The purpose of the meeting was to inform the participants that there was renewed interest in deepening the navigation channels in Fall River, and if Congress authorized funding, a study would be undertaken to determine if the proposed project was viable. It was decided to have a point of contact with each state. The Governor's Office from Rhode Island would be one point of contact, while Secretary Bewick and Fitzpatrick office's would be the point of contacts for Massachusetts. The following agencies were represented at this meeting.

Mass. Energy Office
Mass. Coastal Zone Management
Governor's Office, R.I.
Dept. Env. Management, R.I.
Coast. Res. Center, URI
Sch. of Oceanography, URI
U.S. EPA
N.E. River Basins Comm.
Corps of Engineers

4 June 1980

On this date, a meeting was held in the Massachusetts State Office building. The purpose of the meeting was to determine potential disposal options and to determine state regulatory procedures for the disposal of dredged materials. The results of the meeting were that the two states (Mass. and R.I.) would supply the necessary information. The following agencies were represented at this meeting.

Mass. Energy Office
Mass. Coast. Zone Management
Gov. Policy Office, R.I.
Dept. Env. Management, R.I.
Coast. Resource Ct., R.I.
Sch. of Oceanography, URI
N.E. River Basins Comm.
Corps of Engineers
Fall River Port. Auth.
New England Power

24 October 1980

On this date, a meeting was held at the Massachusetts Coastal Zone Office. The purpose of the meeting was to present the Corps' proposed sampling and testing program for the Fall River channel sediments, and to elicit commentrs from the participants on the adequacies of the program. It was decided at the meeting that the states would need time to evaluate the programs and make suggestions. The following agencies were in attendance.

Mass. Coast. Zone Management
Dept. Env. Management, R.I.
Corps of Engineers

24 October 1980

On this date, a meeting was held between U.S. Environmental Protection Agency and the Corps of Engineer at the JFK Federal building in Boston. The purpose of the meeting was to present the Corps' proposed sampling and testing program, and to elicit suggestions on further testing. EPA accepted the program as presented except they wanted cores instead of grab samples.

17 November 1980

On this date, a meeting was held at the Corps office in Waltham, Massachusetts with the representative for both states. The purpose of the meeting was to discuss further testing required by the two states for the channel sediments. Both states wanted shellfish dredged from the channel and tested for contaminants. They both agreed to have that one representative present their position. It was further agreed to have another meeting on this issue. The following agencies were represented at this meeting.

Mass. Coastal Zone Management (Representing Both States)
Corps of Engineers

14 January 1981

On this date, a meeting was held at Massachusetts Coastal Zone Management Office. The purpose of the meeting was to continue discussions on the sampling and testing program, and also discuss the feasibility of upland disposal for the proposed project. The Corps agreed to undertake the shellfish sampling and testing program, and the states agreed that upland disposal was not an acceptable option for Fall River proposal. The following agencies were represented at this meeting.

Mass. Water Poll. Control
Mass. Coastal Zone Management
R.I. Dept. Environ. Management
URI Coastal Resources
Corps of Engineers

23 June 1981

On this date, a meeting was held in the office of the Massachusetts Energy Secretary. The purpose of the meeting was to discuss the various aspects associated with the use of shoreline containers for disposal of the dredged sediments from the Fall River Harbor project. The two main issues discussed were the funding required for such a structure, and the type of commitment needed from the private interests to give such an option serious consideration. No firm agreements were reached at this meeting. The following agencies were represented at this meeting.

Mass. Energy Office
Mass. Coastal Zone Management
Issues Management
Fall River Port. Auth.
Cong. Heckler's Office
R.I. Dept. Environ. Management
Corps of Engineers
EG & G Synfuels
New England Power

26 June 1981

On this date, a meeting was held in the Massachusetts Coastal Zone Office. The purpose of the meeting was to supply participants with a preliminary package of information to be used at the public workshops to be held for the proposed Fall River project, and to elicit comments from the participants on the information package acceptability. The package was generally acceptable to those present. The following agencies were represented at this meeting.

U.S. EPA
U.S. F&WS
Nat. Marine Fisheries Service
Mass. Water Poll. Control
Mass. Coastal Zone Management
Mass. Dept. Env. Quality Engrg.
Mass. Div. Marine Fisheries
Corps of Engineers
Bay State Env. Consultants, Inc.

29 June 1981

On this date, a meeting was held at the Rhode Island office of the Department of Environmental Management. The purpose of the meeting was to supply participants with a preliminary package of information to be used at the public workshops to be held for the proposed Fall River project, and to elicit comments from the participants on the information package acceptability. The package was generally acceptable to those present. The following agencies were represented at this meeting.

R.I. Dept. Env. Management
URI Coastal Resource Ctr.
URI Grad. Sch. of Oceanography
Corps of Engineers
Bay State Env. Consultants, Inc.

14 and 15 July 1981

On these two dates, public workshops were held at Fall River, Massachusetts and at Jamestown, Rhode Island, respectively. The purpose of these meetings were to inform the public on the progress of the Fall River Harbor study, and to get input from the public. A digest of the public workshops has bene prepared and will be supplied upon request.

FEDERAL, STATE AND LOCAL AGENCIES
FALL RIVER DEIS COMMENTS REQUESTED

FEDERAL

1. U.S. Coast Guard Marine Safety Office, Providence, RI
2. CDR USACE (DAEN-CWP-EO
3. U.S. Coast Guard, Boston, MA
4. U.S. Fish & Wildlife Service, Newton Corner
5. U.S. Navy, Boston, MA
6. U.S. Dept. of Energy, Boston, MA
7. U.S. Dept. of HEW
8. U.S. EPA, Washington
9. U.S. EPA, Boston, MA
10. U.S. Dept. of Commerce (Office of Regulatory Policy), Washington
11. National Marine Fisheries Service, Gloucester, MA
12. U.S. Geological Survey, Woods Hole, MA
13. U.S. Fish and Wildlife Service, Concord, NH
14. National Park Service, Boston, MA
15. Dept. of Housing and Urban Development
16. U.S. Dept. of Commerce-NOAA, Norfolk, VA

STATE

1. Mass. Dept. of Env. Quality Engineering
2. Mass. Historical Commission
3. Mass. Division of Waterways
4. Mass. Cooperative Fishery Unit
5. Mass. Coastal Zone Management
6. Mass. Office of Communities and Development
7. R.I. Coastal Resource Management Council
8. Mass. Division of Marine Fisheries
9. Mass. Division of Water Pollution Control
10. R.I. Division of Planning and Development

LOCAL

1. Conservation Commission - Somerset, MA
2. Conservation Commission - Fall River, MA
3. Fall River Chamber of Commerce
4. Fall River Industrial Development Commission
5. Fall River Office of Economic Development
6. Fall River Public Library
7. Tiverton Public Library

VI. COMPLIANCE WITH ENVIRONMENTAL STATUTES

(1) Preservation of Historical Archeological Data Act of 1974 (16 U.S.C. 469 et seq.), which amends the Act of 27 June 1960, also referred to as the "Reservoir Salvage Act of 1960, amended; National Historic Preservation Act of 1966, as Amended, 16 U.S.C. 470 et seq., Executive Order 11593, Protection and Enhancement of the Cultural Environment, 13 May 1971. The provisions of this Act as amended are applicable. Coordination has been undertaken with the appropriate historic preservation officer. The conclusion reached is there would be no impacts to historical or archeological resources with disposal at the Brenton Reef Disposal site. However, if the Browns Ledge site were used, there is a potential for impacts, and studies would have to be undertaken before the site could be used. We are in compliance with the provisions of this act as amended.

(2) Clean Air Act, as Amended, (42 U.S.C. 7609). The provisions of this Act are applicable and we are in compliance.

(3) Clean Water Act of 1977, (Federal Water Pollution Control Act Amendments of 1972) 33 U.S.C. 1251 et. seq. This is an evaluation of the effects of discharging dredged material into waters of the United States. Coordination with Rhode Island Department of Environmental Management will be initiated with the issuance of the draft EIS.

(4) Coastal Zone Management Act of 1972, as Amended, 16 U.S.C. 1451 et seq. The provisions of this Act are applicable and we will comply with them. Coordination with the two State Coastal Zone Management agencies will be initiated with the issuance of the draft EIS.

(5) Endangered Species Act of 1973, as Amended, 16 U.S.C. 1531 et seq. The provisions of this Act apply and we are in compliance with them. Coordination has ben initiated with the National Marine Fisheries Service to determine if there are any endangered species found in the study area. Continued coordination will be maintained.

(6) Estuary Protection Act (16 U.S.C. 1221 et seq.) Provisions of this Act are applicable to this project and we are in compliance with them.

(7) Federal Water Project Recreation Act (16 U.S.C. 460-12 et seq.) The provisions of this Act are applicable to the project and we are in compliance with them.

(8) Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.) The provisions of this Act are applicable and we are in compliance. Coordination with the U.S. Fish and Wildlife Service and the National Marine Fisheries has been carried out and continued coordination will be maintained.

(9) Land and Water Conservation Fund Act (16 U.S.C. 4601 et seq.) Provisions of this Act are applicable to the project and we are in compliance.

(10) Marine Protection Research and Sanctuaries Act of 1972, as amended (16 U.S.C 1401 et seq.) Provisions of this Act apply to this project. Coordination with the Environmental Protection Agency will be initiated with the issuance of the draft EIS.

(11) National Historic Preservation Act (16 U.S.C. 470a, et seq.) Coordination has been undertaken with appropriate historic preservation officer. The conclusion reached, is there would be no impacts to historical or archeological resources with disposal at the Brenton Reef Disposal site. However, if the proposed Browns Ledge site were used, there is a potential for impacts, and studies would have to be undertaken before the site could be used.

(12) National Environmental Policy Act (42 U.S.C. 4321 et seq.) Provisions of this Act are applicable to this project and we are in partial compliance at this time.

(13) River and Harbor Act (33 U.S.C. 401 et seq.) Not applicable.

(14) Watershed Protection and Flood Prevention Act (16 U.S.C. 1001 et seq.) Not applicable.

(15) Wild and Scenic Rivers Act (16 U.S.C. 1271 et. seq.) Not applicable.

(16) Executive Order 11988, Floodplain Management, 24 May 1977. Not applicable.

(17) Executive Order 11990, Protection of Wetlands, 24 May 1977. This executive order is applicable to the proposed project and we are in compliance.

(18) Executive Order 12114, Environmental Effects Abroad of Major Federal Actions, 4 January 1979. Not applicable.

(19) Executive Memorandum Analysis of Impacts on Prime and Unique Farmlands in EIS, CEQ Memorandum, 30 August 1976. Not applicable.

VII. LIST OF PREPARERS AND CONTRIBUTORS

Name	Profession	Education	Experience	Contribution
William Coleman	Civil Engineer	B.S. and M.S. Civil Engineering	17 years Federal Service with DoD	Project Manager EIS Preparation
B.E. Barrett	Ecologist	Ph.D. Zoology M.S. Zoology B.S. Zoology	Fisheries Mgt. and Research, 6 years Suprv. Environmental Studies Planning Division CE, 8 years	EIS Preparation and Staff Coordination
Diana Halas	Geographer	A.B. Geography	CE, 6 years	EIS Preparation
Richard Ring	Economics	M.S. Economics B.A. Economics	CE, 8 years	EIS Preparation
John Wilson	Archaeologist	M.A. Anthropology B.A. Anthropology	Archaeologist CE, 5 years Consultant, 3 years	EIS Preparation
William Lawless	Civil Engineer, P.E.	M.S. Civil Engineering B.S. Civil Engineering	Consultant, 15 years Ch., Regulatory Branch, Operations Div., 9 years	EIS Preparation
Vyto Andreliunas	Civil Engineer, P.E.	B.S. Civil Engineering	Ch., Operations Division CE, 26 years	EIS Preparation
Del Kidd	Ecologist	B.S. Zoology B.S. Economics	National Marine Fisheries Service, 5 years CE, 10 years	EIS Preparation

*Corps of Engineers
**Department of Defense

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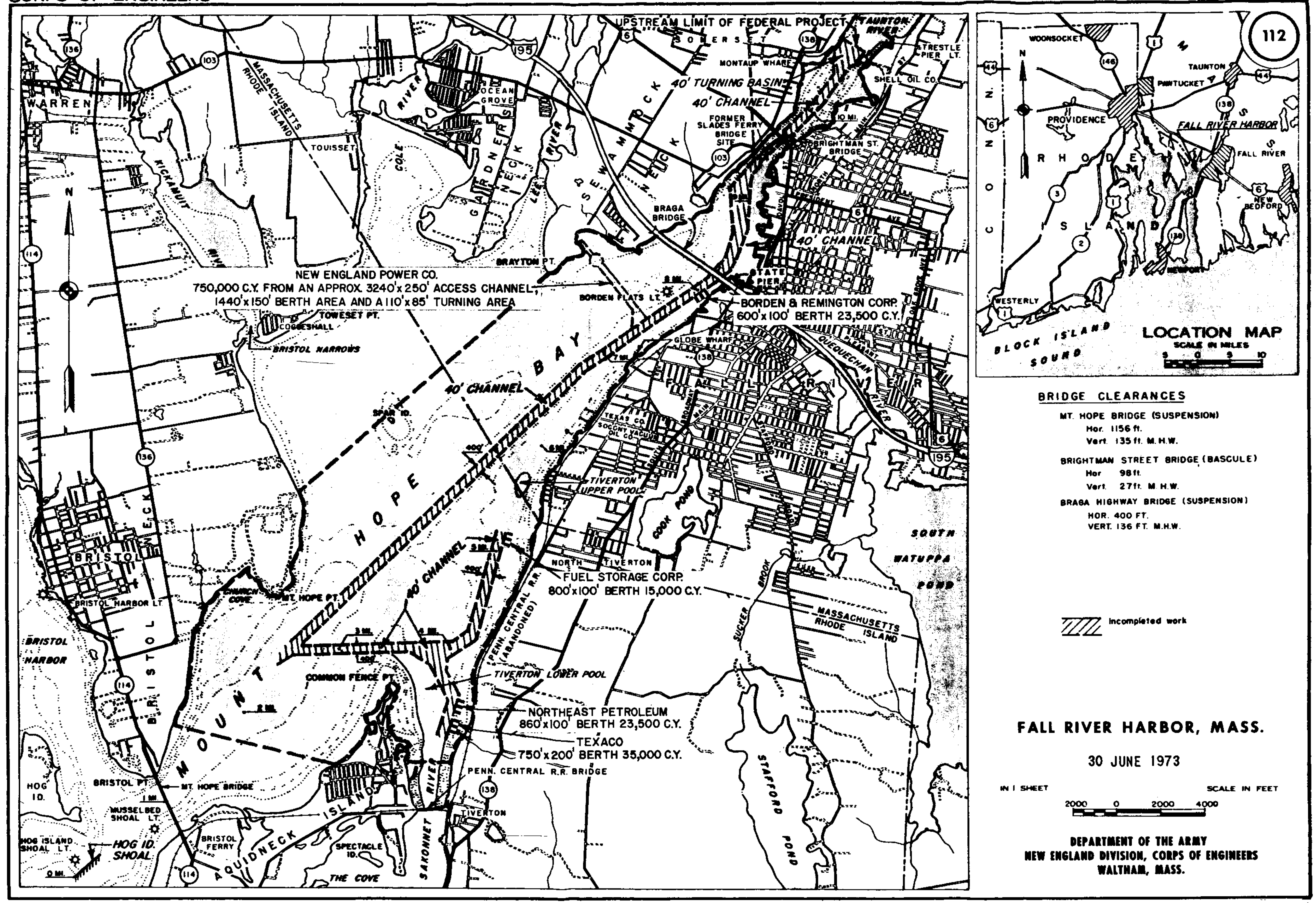


UPSTREAM LIMIT OF FEDERAL PROJECT
TAUNTON RIVER
SOMERSET
MONTAUP WHARF
TRESTLE PIER LT.
SHELL OIL CO.
40' TURNING BASIN
40' CHANNEL
FORMER SLADES FERRY BRIDGE SITE
BRIGHTMAN ST. BRIDGE
BRAGA BRIDGE
40' CHANNEL
STATE PIER
BRAYTON PT.
BORDEN FLATS LT.
NEW ENGLAND POWER CO.
750,000 C.Y. FROM AN APPROX. 3240'x250' ACCESS CHANNEL
1440'x150' BERTH AREA AND A 110'x85' TURNING AREA
BORDEN & REMINGTON CORP.
600'x100' BERTH 23,500 C.Y.
GLOBE WHARF
QUEQUECHAN RIVER
FALL RIVER
TEXAS CO.
SOCONY VACUUM OIL CO.
TIVERTON UPPER POOL
COOK POND
SOUTH WATUPPA POND
NORTH TIVERTON
FUEL STORAGE CORP.
800'x100' BERTH 15,000 C.Y.
MASSACHUSETTS
RHODE ISLAND
PENN. CENTRAL R.R. (ABANDONED)
TIVERTON LOWER POOL
NORTHEAST PETROLEUM
860'x100' BERTH 23,500 C.Y.
TEXACO
750'x200' BERTH 35,000 C.Y.
PENN. CENTRAL R.R. BRIDGE
TIVERTON
SAKONNET RIVER
STAFFORD POND
SUCKER BROOK
WARREN
MASSACHUSETTS
RHODE ISLAND
TOUISSET
KICKAMUIT RIVER
COLE RIVER
OCEAN GROVE
GARDNERS NECK
LEE RIVER
SEWAMMOCK NECK
TOWESET PT.
COGGESHALL
BRISTOL NARROWS
MOUNT HOPE BAY
40' CHANNEL
SPAR ID.
BRISTOL
BRISTOL NARROWS
BRISTOL HARBOR LT.
CHURCH COVE
MT. HOPE PT.
BRISTOL NECK
BRISTOL HARBOR
COMMON FENCE PT.
MOUNT
BRISTOL PT.
MT. HOPE BRIDGE
HOG ID.
MUSSELBED SHOAL LT.
HOG ISLAND SHOAL LT.
HOG ID. SHOAL
BRISTOL FERRY
AQUIDNECK ISLAND
SPECTACLE ID.
THE COVE
N
LOCATION MAP
SCALE IN MILES
WOONSOCKET
TAUNTON
PAWTUCKET
PROVIDENCE
FALL RIVER HARBOR
FALL RIVER
NEW BEDFORD
NEWPORT
WESTERLY
BLOCK ISLAND SOUND
CONN.
RHODE ISLAND
MASS.
112
BRIDGE CLEARANCES
MT. HOPE BRIDGE (SUSPENSION)
Hor. 1156 ft.
Vert. 135 ft. M.H.W.
BRIGHTMAN STREET BRIDGE (BASCULE)
Hor. 98 ft.
Vert. 27 ft. M.H.W.
BRAGA HIGHWAY BRIDGE (SUSPENSION)
HOR. 400 FT.
VERT. 136 FT. M.H.W.
Incompleted work
FALL RIVER HARBOR, MASS.
30 JUNE 1973
IN 1 SHEET
SCALE IN FEET
2000 0 2000 4000
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

Figure 1

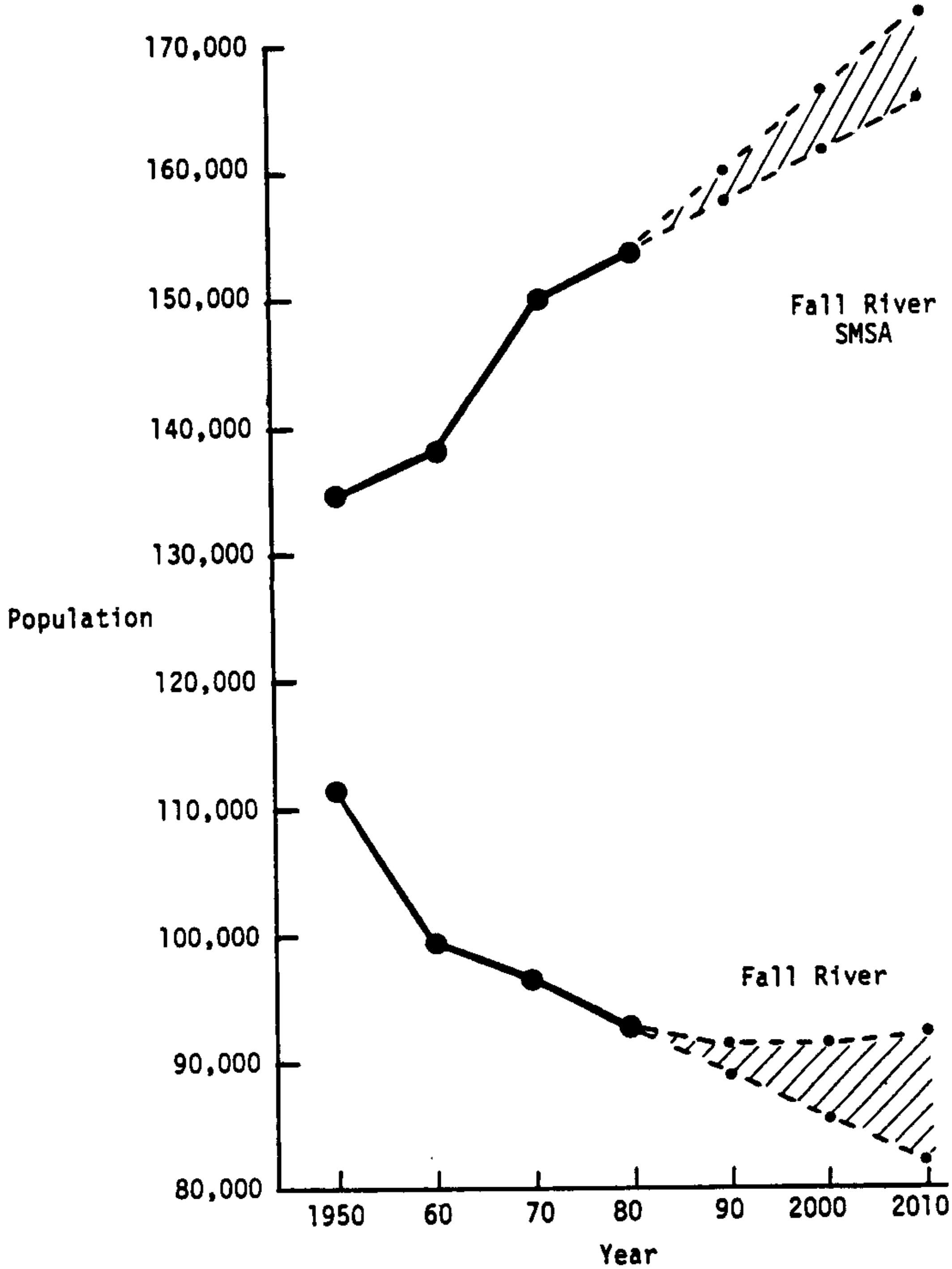


Figure 2--Population trends and projections for the Fall River SMSA and the City of Fall River from 1950-2010.

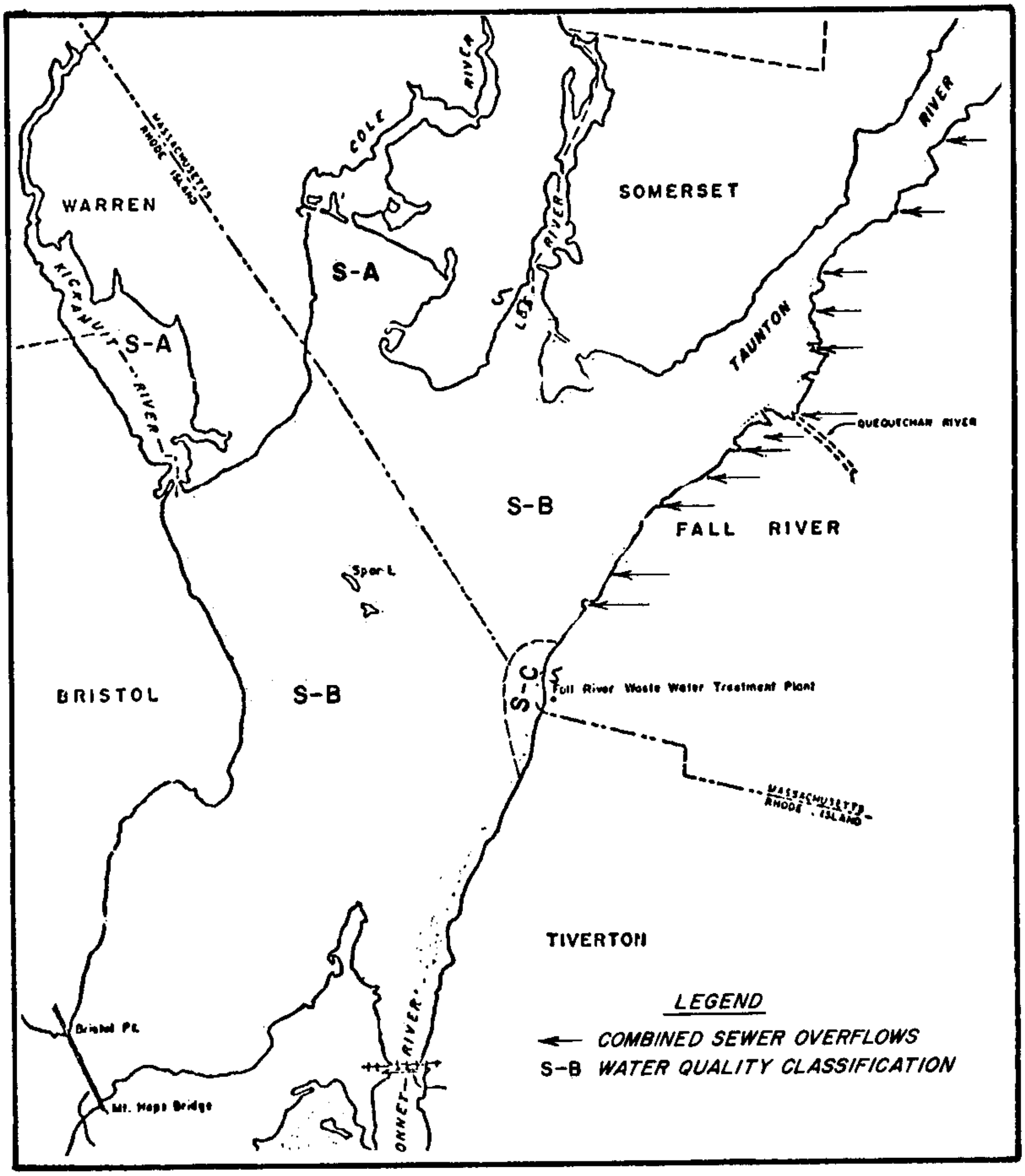
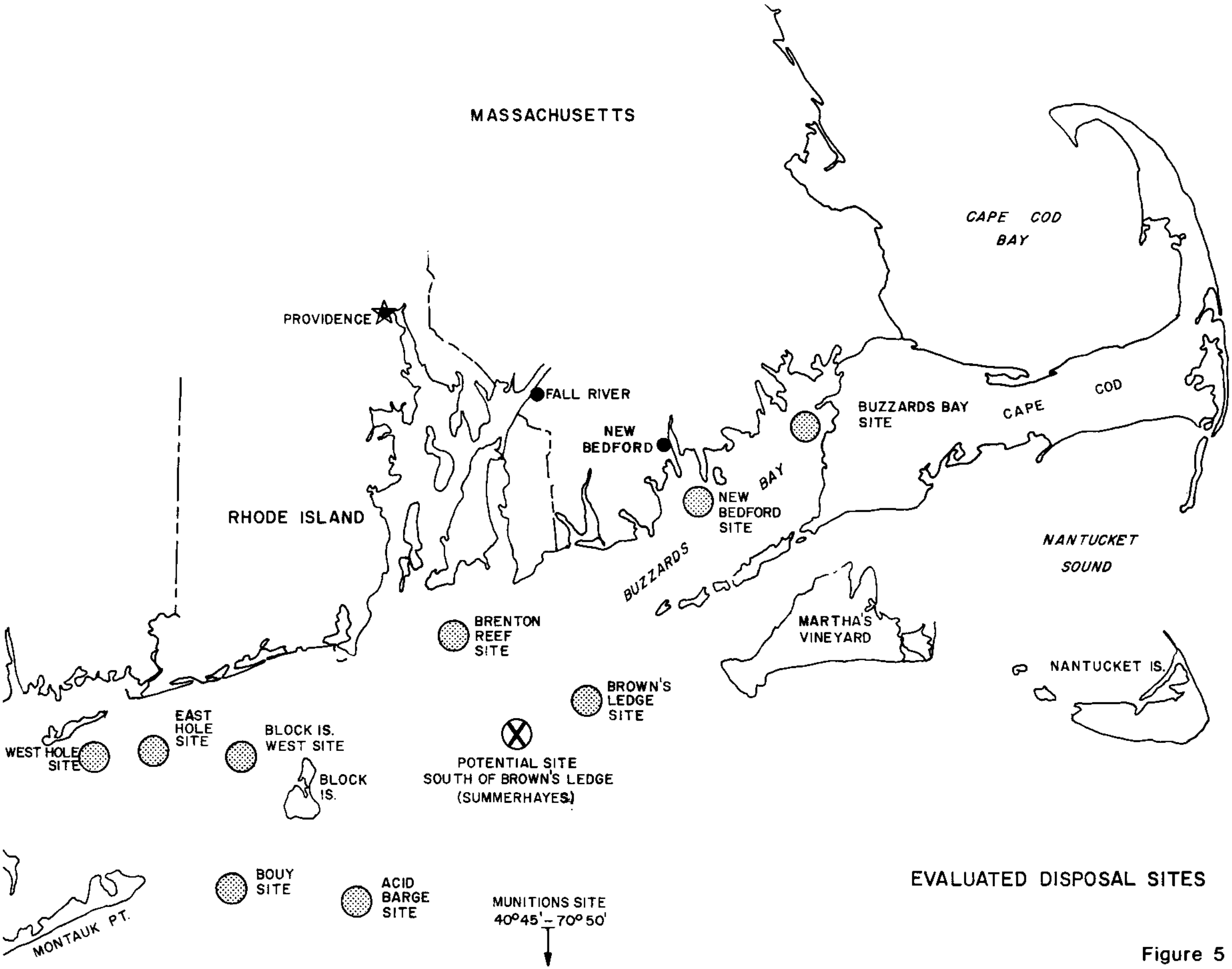


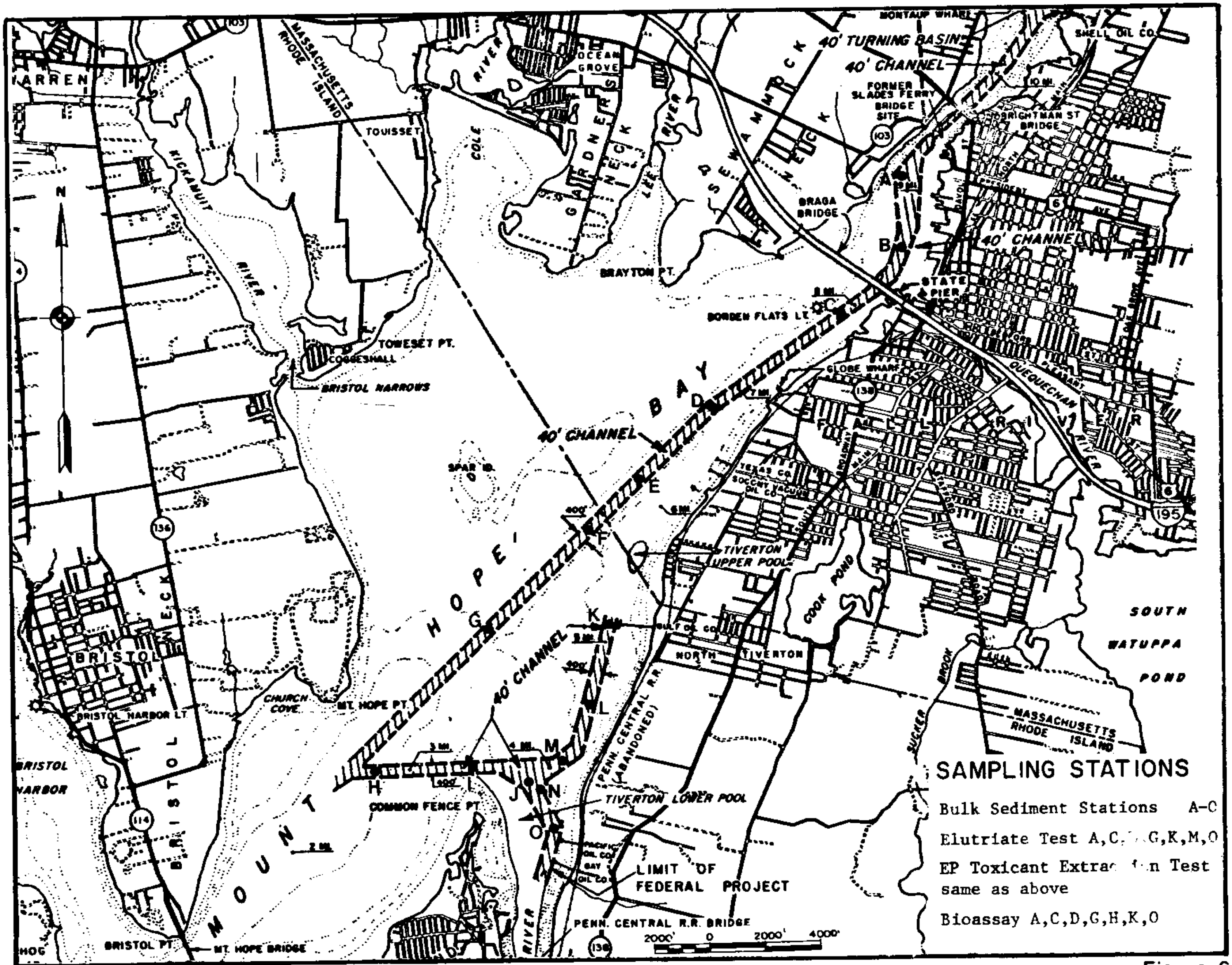
Figure 3--Water Quality Classification and Sewer Discharge


NERBO
SITE EVALUATION
FIGURE 4



EVALUATED DISPOSAL SITES

Figure 5


WARREN
MASSACHUSETTS
RHODE ISLAND
TOUISSET
COLE RIVER
OCEAN GROVE
GARDNERS NECK
LEE RIVER
SEWAMMOCK NECK
MONTAUP WHARF
40' TURNING BASIN
40' CHANNEL
SHELL OIL CO.
FORMER SLADES FERRY BRIDGE SITE
BRIGHTMAN ST BRIDGE
103
BRAGA BRIDGE
BRAYTON PT.
BORDEN FLATS LT
STATE PIER
N
KICKAMUIT RIVER
TOWESET PT.
COGGESHALL
BRISTOL NARROWS
GLOBE WHARF
138
MOUNT HOPE BAY
40' CHANNEL
QUEQUECHAN RIVER
FALL RIVER
SPAR ID.
TEXAS CO.
SOCONY VACUUM OIL CO.
6
195
136
TIVERTON UPPER POOL
COOK POND
SOUTH WATUPPA POND
GULF OIL CO.
NORTH TIVERTON
BRISTOL NECK
BRISTOL
BRISTOL HARBOR LT
CHURCH COVE
MT. HOPE PT.
PENN. CENTRAL R.R. (ABANDONED)
SUCKER BROOK
MASSACHUSETTS
RHODE ISLAND
BRISTOL HARBOR
114
COMMON FENCE PT.
TIVERTON LOWER POOL
PACIFIC OIL CO.
BAY OIL CO.
LIMIT OF FEDERAL PROJECT
PENN. CENTRAL R.R. BRIDGE
BRISTOL PT.
MT. HOPE BRIDGE
HOG
RIVER
2000' 0 2000' 4000'
A
B
C
D
E
F
G
H
I
J
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L
M
N
O
SAMPLING STATIONS
Bulk Sediment Stations A-C
Elutriate Test A,C, G,K,M,O
EP Toxicant Extrac n Test
same as above
Bioassay A,C,D,G,H,K,O

Figure 6

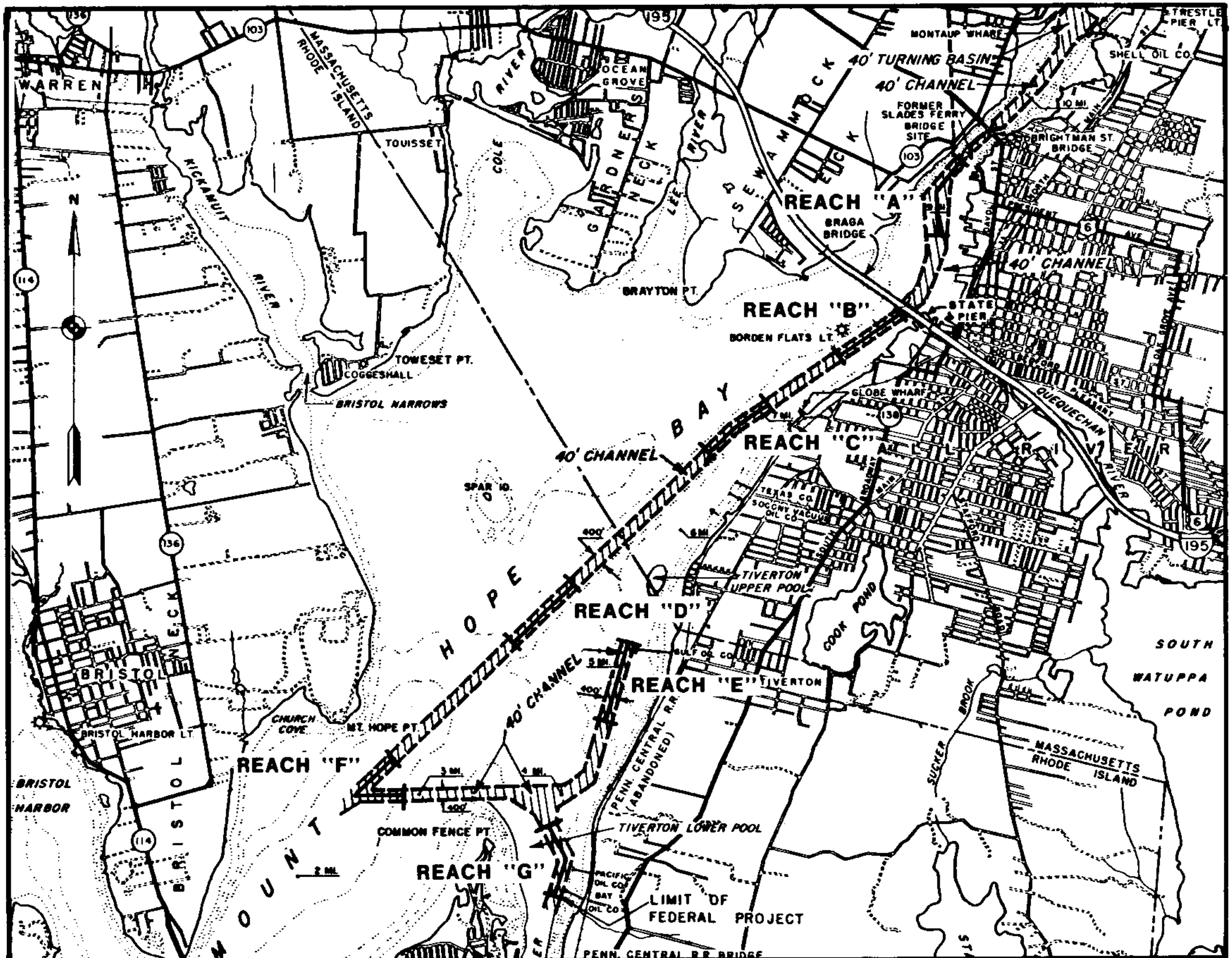

Figure 7--Samples of sediment were systematically collected with a core sampler from five sites in each reach except Reach B, in which four sites were sampled.

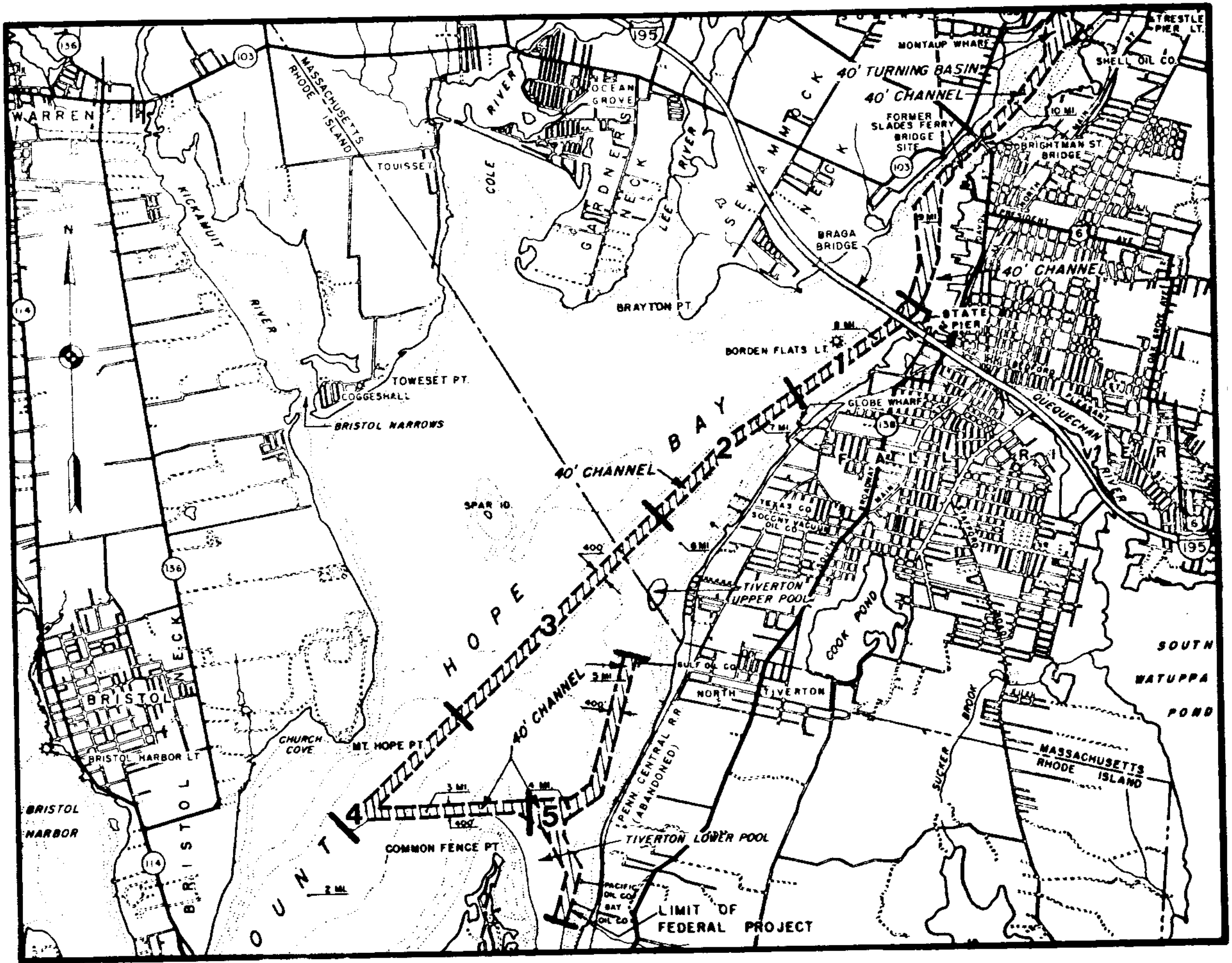

Figure 8 -- Sediment sampling reaches for volumes and properties

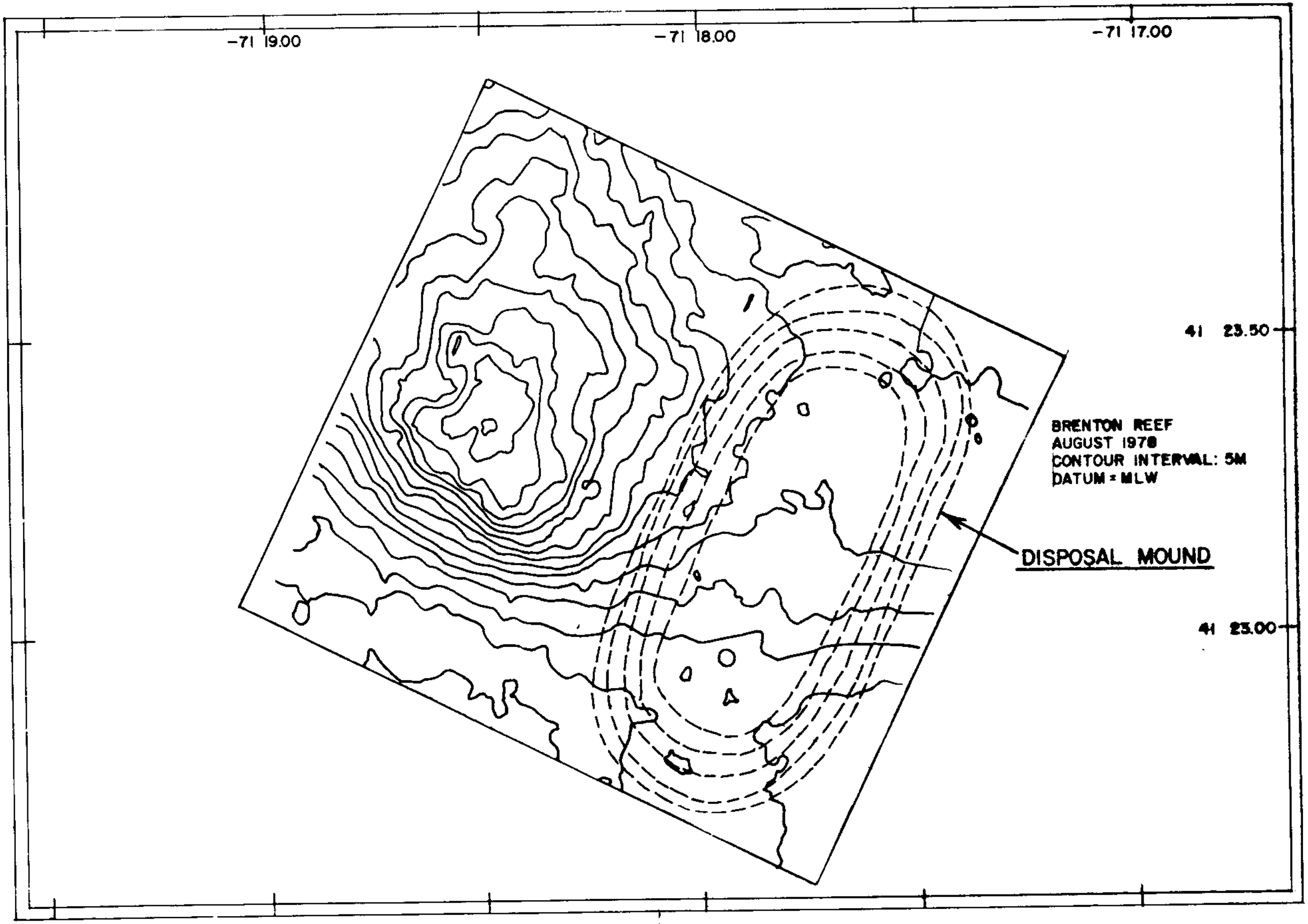

Figure 9 -- Mound configuration at Brenton Reef